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Engineering News-Record

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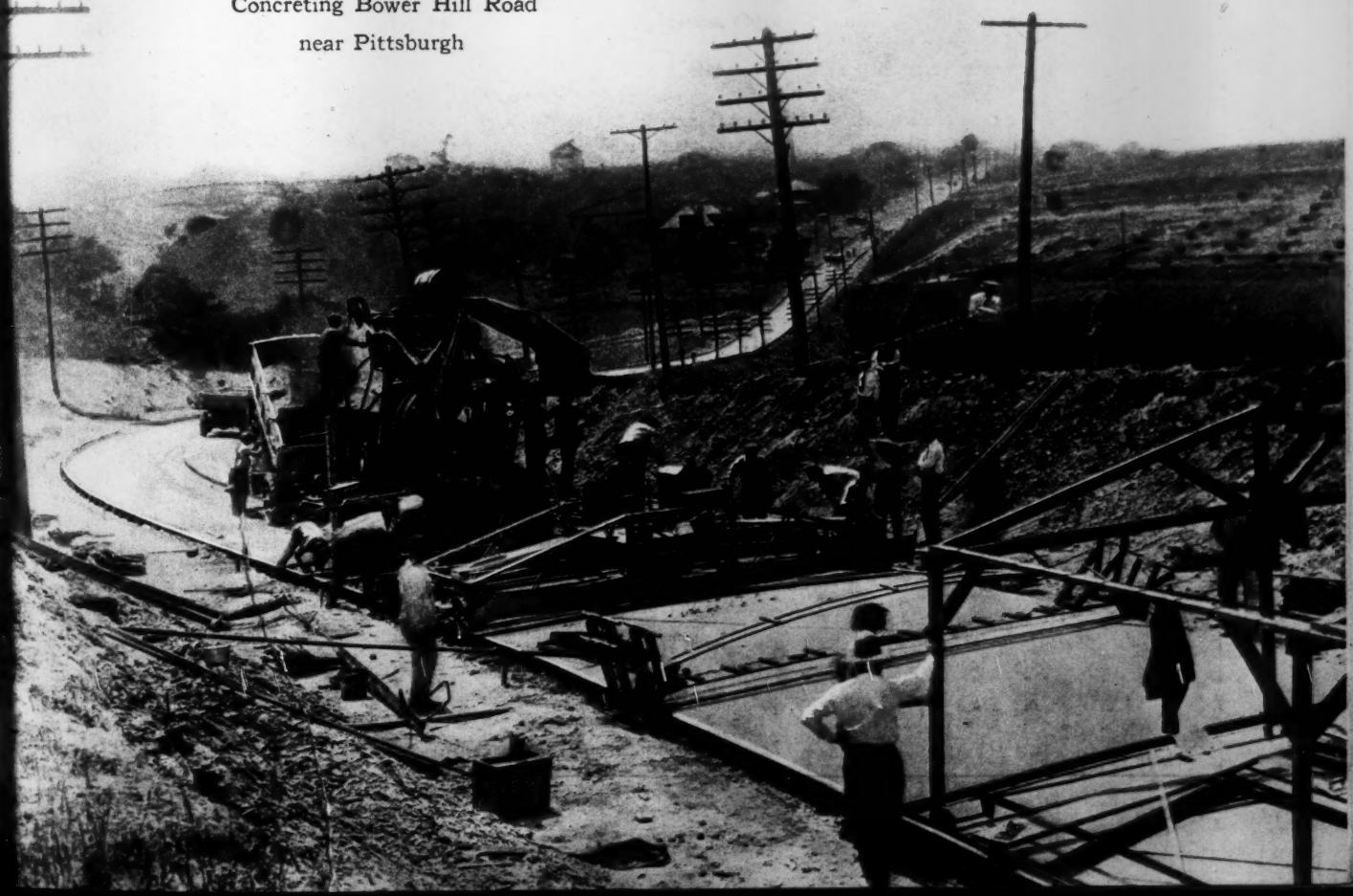
October 13, 1927

Concreting Bower Hill Road
near Pittsburgh



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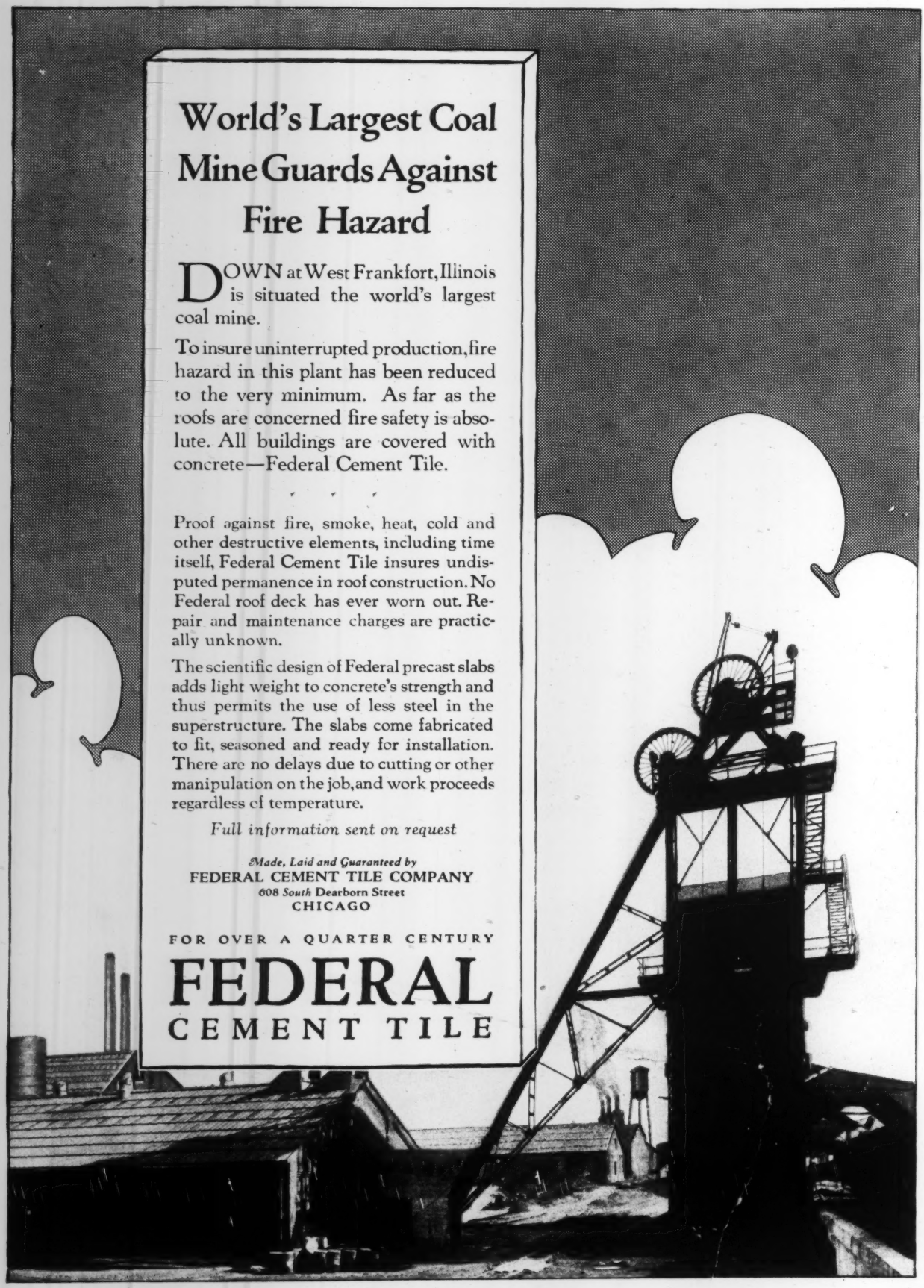


A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

Volume 99 NEW YORK, OCTOBER 13, 1927 Number 15

A Noteworthy Competition

WITH the receipt of competitive bids for the great Hudson River bridge at Fort Lee certain questions that aroused much animosity are disposed of. The proposal to use eyebars for the main cables of this structure, or more correctly speaking the proposal to consider the use of eyebars on even terms with wire, stirred up a small storm. As one of its effects, the legislature of New Jersey even went so far as to give the governor veto power over all contracts which the Port Authority proposed to execute, and the New York legislature in return subsequently passed a corresponding law. Whatever may have been the motives or apprehensions back of this stir, the bids now show the wisdom of pitting the two types of construction against each other. The competition was exceedingly close, and the prices bid are undoubtedly very low indeed. An outstanding result is the proof that the wire cable has a substantial margin of advantage over its competitor, roughly ten per cent of the total cost of the steel structure. Some of the difference may be attributable to the fact that three manufacturers competed for furnishing the wire cables, while at present only one shop is equipped to make the specified eyebars and only one bid was offered. In view of the usual range of bids on any large piece of work, however, the difference between wire and eyebar construction can hardly be considered very significant especially as the bids on the plain steelwork differed nearly as much. The two types will henceforth be in the position of direct competitors. Price, of course, is not the only factor in the comparison. Permanence, rigidity, ease of making connections and relative unit stresses all enter the case, and some of these factors will doubtless receive fuller consideration in future than they have heretofore had. The general parity of the two types, however, will probably remain as the present bidding establishes it.

The Lonesome Expert

TECHNICAL experts, says the Baltimore *Sun* in commenting on the recent axe-swinging by the mayor of that city, have few political friends. Political as here used may be extended to cover the whole body of voters, the mass of whom perhaps have smaller friendship for the expert than do the few who are elected to office. If the body politic had more regard for technical experts the office holders would reflect it quickly enough, but naturally knowing little of what constitutes expert knowledge and ability and having little means of weighing and valuing it, they think one expert—or let us say one engineer—as good as another, and as between two share the out-and-out politician's preference for their own political brand. One thing that the public and the politician alike should be able to understand is that long-continued public service should be rewarded, when efficient, by continuance in office. But here comes in the ingratitude of republics, which extends to cities as well. It is party rather than public service that claims the reward, and gets it at the hands of the party politicians unless prevented by the expressed will of the people. Fortunately there are exceptions both as to cities and individuals. That has been proved heretofore by Baltimore as a city and by many of its mayors as individuals, in the continuance of able engineers in office through successive administrations, as noted in our news and editorial sections last week. It is this that makes all the more odiously striking the action of the present mayor, particularly in the displacement of Major Shirley after more than three decades of notable service with unquestioned capacity for still further great usefulness to Baltimore.

Safety and the Engineer

THAT the "safety" movement is becoming a highly important factor in industry and in various lines of human activity was illustrated conspicuously by the large attendance at the recent National Safety Congress in Chicago and the wide range of its proceedings. This movement has two great motives, economic and humane. For humane reasons alone it is desirable to conserve health and energy and to reduce the number of deaths and injuries resulting from accidents of various kinds. But beyond this there is increasing recognition of the importance of safety protection. Cases of sickness and preventable accident affect not only employers and employees, but also the community in general. Thus a foreman or a skilled workman with good pay may become a cripple, able to do only odd jobs. His ability and mechanical skill are lost to his employer, who may also be at expense for insurance and compensation. Furthermore, the man's buying power is reduced, which affects the community. It may be that he and his family come upon the public for support, so that as a result of the accident he becomes a liability instead of an asset to the community. The same condition applies, in heightened degree per individual, in the case of higher officials, whose loss or enforced retirement interferes with the steady operation of industrial management. It applies, in fact, to every line of human activity. For instance, a child who might become an important asset to his community or his country by reason of skill or knowledge, may meet with a preventable accident which converts him into a human liability. With the increasing intensity of human activities, both in business and in leisure, there is of necessity an increasing tendency to accidents of various kinds. To check this tendency is a field for organizations devoted to the promulgation of educational publicity as to the practical and economic value of safety methods, training, appliances and habits. As a result of such work, "safety" teachings are being more and more widely understood and applied in various lines of manufacture and industry, in railway and high-

way transportation, and in many special lines, such as engineering construction work. This movement is in fact one of the many special activities in which the engineer has found an opportunity to devote his knowledge and training to the public welfare.

Pedestrian Tunnels

EVEN if it be held that conditions at Highland Park and its surrounding neighbor, Detroit, are exceptional there is much general significance to the recent voting of $150,000 in the smaller place for 14 additional pedestrian tunnels and in the fact that Detroit also has some of these facilities for evading the ubiquitous automobile. The tunnels in these two cities are located at and near public schools and thus are designed primarily to safeguard the youthful. Unless present tendencies are checked—and acceleration seems more likely—pedestrian tunnels may become necessary elsewhere than near schools. Probably they should be a last resort. The $150,000 voted at Highland Park provides for but 14 of these undercrossings. Their general use in dense traffic sections would be very costly, and the money they would cost could be more advantageously used for more fundamental remedies, such as street widening—to say nothing of the fact that no one wants to be alternately plunging below and climbing above ground.

The Gros Ventre Slip

THE landslide that choked the channel of the Gros Ventre River in Wyoming two years ago and this year suddenly released enough of the impounded waters to cause a fatal and disastrous flood, provides food for thought. The facts of the washout are published elsewhere in this issue. This great natural barrier, a dam 1½ miles thick through the base, impounded water for two years and created a false impression of stability. When the failure came, rock was fortunately encountered by the rapidly cutting channel at a depth of only 45 ft. below lake level, and hence the flood was limited to the quantity impounded in the upper 45 ft. of the reservoir. Had the soft material extended to a greater depth, the flood would have been more serious. The feeling of confidence that permitted community life to continue in tranquility just below the lake it formed may have been due in part to the fact that earth-fill dams with a far lighter cross-section than that of the Gros Ventre barrier are perfectly safe. But an earth dam as built by man has its materials so graded as to give maximum resistance to the percolation of water. When material is deposited by such haphazard process as a landslide, on the other hand, there is only partial control of sequence of placement, and no gradation of material. Quantity of material alone is no assurance of stability or security in a structure that must retain water.

Motor Vehicle Regulation

MOTOR-BUS operators are getting behind the proposal to have Congress pass some well considered laws for the regulation of buses in interstate operation. They are coming to realize more and more that while interstate regulations may have some disadvantages, the advantages will more than offset them. If the results obtained in railroad legislation can be taken as a parallel, the setting up of a federal law which will be applicable in all states will tend to eliminate many of the vagaries of the state laws. Motor truck operators, unfortunately, have not yet seen the light. Most of them still hold to the theory that the motor truck is a God-given agency which should not be regulated by any body, state or federal, lest its development be impeded. Those who have to do with the repair and maintenance of streets and highways hold quite opposite views. They, with many others, are of the opinion that careful regulation of truck movements would help to solve some of their troubles. Members of our state and federal commissions set up for the regulation of utilities seem to be of like mind. Last year, at the annual meeting of the association made up of such officials, the plea of the truck operators that they be left unregulated was not well received but the association did not take any definite action upon it. This year when the association meets (at Dallas, Texas, Oct. 18, 1927) the situation may be changed. During the year that has elapsed much has been learned upon the subject of bus and truck operation, chiefly through the investigation conducted by the Interstate Commerce Commission preparatory to making recommendations to Congress on the subject of buses and trucks engaged in interstate commerce. It seems more than likely that the association will endorse a plan for at least a limited form of regulation for truck operators. If it does there is a better chance than last year of having Congress act favorably on the subject, for the National Association of Railroad and Utilities Commissioners provides a fair cross-section of the sentiment on such subjects throughout the country.

Government in Standardization

AN IMPORTANT reorganization of the Bureau of Standards was announced last week: its division into two groups, one of them to be composed of the activities originated by Secretary Hoover in the field of simplification of types and varieties of manufactured products. The Bureau's old work, that of testing, research, and weights and measures, will go on as before, and will form the second group. The new group, which is to carry the name Commercial Standards, has been formed in recognition of the importance of standardization in the commercial world, says the formal announcement.

Offhand, it seems fitting that work on commercial standards should be grouped in the Bureau of Standards. But words do not always make facts. The new group of activities is primarily based on negotiation, compromise and arbitrary adjustment, and there is enough incongruity between such work and the scientific or technical work of the other group as to raise some question whether this marriage of opposites will work out happily. We have every confidence that the activity of the great laboratory at Washington will continue to be as productive and valuable as in the past. The importance of the new arrangement lies in its potential effect on the simplification work itself. Initiated by Secretary Hoover six years ago and closely identified with his personality ever since, it has depended at all times on the willing and even enthusiastic co-operation of industry. Such co-operation was given to Mr. Hoover, but it is not at all certain that it will be given to a formally established bureau.

The fact cannot be ignored that leading and assembling various industrial groups to induce them to work out their own economic problems is by no means a natural function of government as we have known it for one

hundred and fifty years. But each new generation faces human problems of a new kind, and under today's conditions the promotion of commercial standards by government may prove to be an essential constructive factor in future industrial progress. Unquestionably, the possibilities of commercial standardization are remarkably broad. In the end industry itself must take the lead toward attaining these possibilities. It has heretofore done so only in a few narrow fields, within the circle of some technical and industrial associations; it has failed altogether to organize for comprehensive attack on the problem. Government now offers a helping hand toward the result. The success of the governmental move, we believe, will depend on how quickly it can persuade industry and commerce to take over the work themselves.

A Makeshift Directorate Plan

DISTRUST of the governing bodies of American cities has been shown for decades past whenever a public enterprise of unusual size and cost has been undertaken. Frequently this results in creating a special board or commission, which oftentimes is not strictly responsible to the voters, the city government or anybody else, or at best has a much divided responsibility. Many times in the past this has proved to be unsatisfactory.

A striking example of the kind is afforded by that part of the "Untermyer plan" for meeting the transit needs of New York City which provides for a board of nine directors, the majority of whom would represent commercial organizations, while of the other four three would represent the city and one would be chosen by the eight, with the mayor of New York breaking any tie vote on this matter only. Of the three city representatives, only one would be chosen primarily as a director, and that one by the mayor. The other two would be city officials, serving as directors ex-officio: one appointed by the mayor as chairman of the existing Board of Transportation, engaged in building new subways; the other being the city controller, an elective officer. The people, in electing the city controller, would be choosing one director, and in electing a mayor would be represented in the choice of two more, but few of them would be conscious of the fact when casting their ballots.

Such a diversity of methods of choosing directors with a corresponding diversity of interests represented, means divided responsibilities. The director elected by popular vote—primarily as controller—owes his allegiance to the voters. The two appointed by the mayor owe allegiance to him. The mayor and controller, both popularly elected, and the two highest officials of the city, are likely to be at odds, and thus the mayor's appointees and the controller-director. The five representatives of commercial organizations, constituting a majority of the directorate, represent general business and real estate interests, in four city boroughs. The membership of these organizations is but a small percentage of the voting population of the boroughs they represent and smaller yet of the entire city. Moreover, in at least some of these organizations membership is not confined to residents of New York City. The only representatives of the people as a whole are the controller-director, the transportation-board-chairman director and the mayor's more personal representative. The ninth member, designated president, is subject to control by the other eight who fix his salary and can remove him at will.

Responsibility of the members of either a commercial or city board is determined largely by whether anyone, and if so then who, has the power of removing them. In the generally accepted theory of administration, power of removal before expiration of term of office goes with that of appointment. Under the Untermyer plan, the three directors who owe their positions, directly or indirectly, to popular vote, cannot be removed by the voters or by their representatives in the city government. The plan does not authorize the mayor to remove either of his appointees, but presumably he can remove the one appointed primarily as chairman of the board of transportation. The president could join with any five other directors in the remarkable course made possible by the Untermyer plan. That is, any of the five directors representing commercial organizations may be removed from office at any time by 6 other of the 9 directors. This makes possible various combinations of the three groups of directors, limited in aim to some one or more of the five representatives of commercial organizations. Next in objectionableness to a self-perpetuating governing body dealing with municipal affairs is one with power of removing even a part of its own members. The only saving grace in this instance is that successors to the removed directors can be appointed only by the organizations represented by the deposed directors. This does not go far toward removing the objection to the plan.

Objections to the Untermyer transit director plan do not stop with questions of governmental responsibility. The minority representation of the city government on the proposed transit board lessens the power of the city administration to adjust obligations for transit to the needs of the city for numerous other objects, some even more vital than transit.

Warrant for discussing this plan at such length lies chiefly in the distrust of the personnel of American city governments that, as we said at the beginning, has given rise for decades past to attempts, some possibly worse and some certainly better than this one, to safeguard large municipal enterprises, especially those of unusual character, magnitude and cost, by entrusting their execution, if not also their administration, to some extra-governmental body.

The more desirable of two ways of meeting this undeniably serious problem would be for the voters of America to choose more efficient and trustworthy civil servants, for it is the voters upon whom the blame must rest. Improvements to that end are being made, but progress is slow, uncertain—and sometimes backwards. Meanwhile, the unfortunate conditions that persist must be met as well as may be. In many if not most cases those who make the attempt would be quite as likely to get their plans adopted, and far more likely to see them prove effective, if they would rely less upon seemingly happy but really haphazard means to that end, and in place of old and untrustworthy schemes for checks and balances address themselves to finding a plan that will clearly fix responsibility for both the choice of administrative officials and for their removal and replacement if they prove to be incompetent or unfaithful. The Untermyer plan here discussed scatters the responsibility for the choice of directors, provides no means for holding them responsible, individually or collectively, except a makeshift means of removing a portion of the directors, left to the directors themselves for execution.

Allegheny County Develops Ultimate Highway System Plan

A System of Radial and Belt Roads Having Pittsburgh as a Center Is Being Constructed in a County of Successive Hills and Ravines Cut Fanwise by Three Great Rivers

ALLEGHENY County is one of the remarkable counties of America in its technical and financial setup for county road improvement. It has come to this position in a few years, and the development holds a story of interest. In Pittsburgh the county has a predominating focus for its highway traffic, but all along the rivers and among the hills a numerous growth of industrial and suburban residence towns has created other foci which have determining influence on road location. Into this situation geography and topography intrude a complexity of natural barriers of hills and rivers which has few equals in counties which are centers of large population. Together the conditions, industrial and physical, make a unique situation even for this era when demand is creating plans overnight for costly road systems.

Geography and Topography—The coming together, at about the county's center, of the Ohio, the Allegheny and the Monongahela rivers divides Allegheny County into three approximately equal sectors. At the immediate junction is the city of Pittsburgh, itself divided into three minor sectors by the rivers. Pittsburgh has a rugged topography, a succession of hills and valleys somewhat smoothed out by the necessities and operations of constructing a city, but still very rough. The main valleys are of course where the big rivers flow. Outside of Pittsburgh the whole county has identical topographical characteristics, rugged hills separated by the main valleys of the big rivers and the secondary valleys of a multitude of streams flowing into these rivers. A section of the county embracing half a score of townships west and north of the city is shown by Fig. 1. The contours show a veritable jumble of hills and ridges rising precipitously from 200 ft. to 500 ft. above the stream valleys. This portion of the county is typical of all, not the roughest nor the smoothest but about the average. Except for stretches of river bank here and there along the main rivers and Neville Island in the Ohio River there is no level land, making both road location and construction extremely difficult.

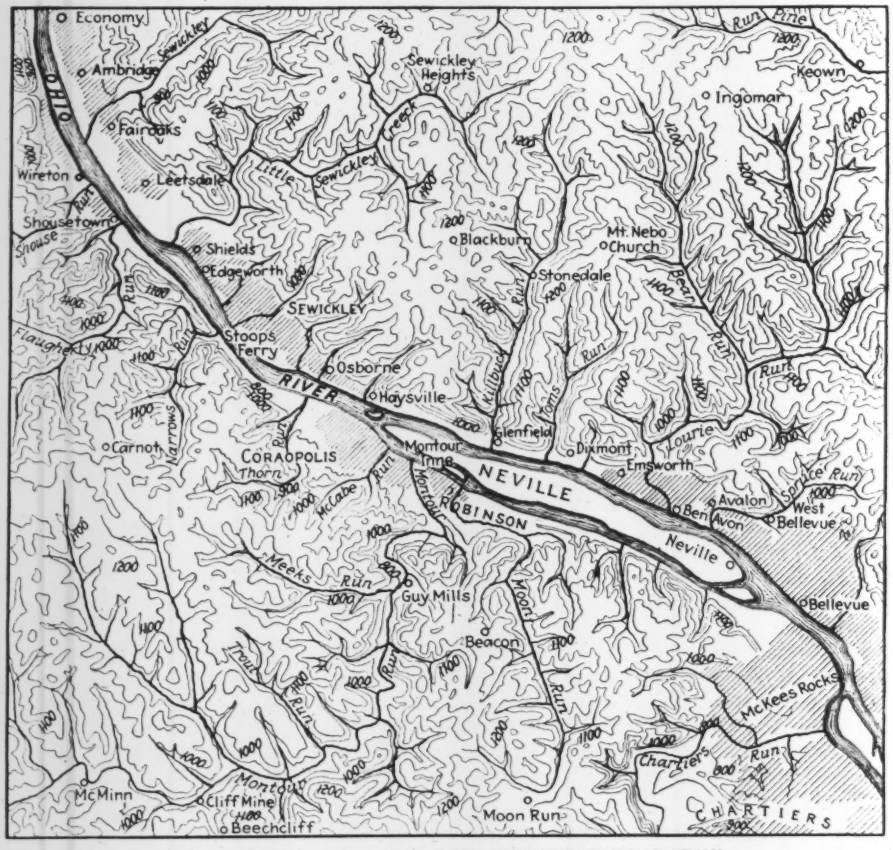


FIG. 1—TYPICAL ALLEGHENY COUNTY TOPOGRAPHY

Traffic Development—Originally the streams and the trails along their banks were the routes of travel. With the coming of railways the same river valleys were followed and in time were pretty well pre-empted as regards transportation route locations. As wagon roads developed out of the trail stage they too took the valley routes seizing such locations as were free from railways. At first and for a long time Pittsburgh was the focus of all routes. Railways and highways formed a spoke system with Pittsburgh as a hub. This was the situation in 1894 when the people of the county began to become highway conscious. Then a legislative act was secured which authorized the county commissioners to assess taxes for the purpose of building and maintaining county roads.

With the emergence from primitive highway conditions there was no radical change of road plan nor any occasion for change. In 1894 the present use of motor vehicles was not anticipated. The county roads were laid out and constructed on the basis that horsedrawn vehicles were the established mode of transportation.

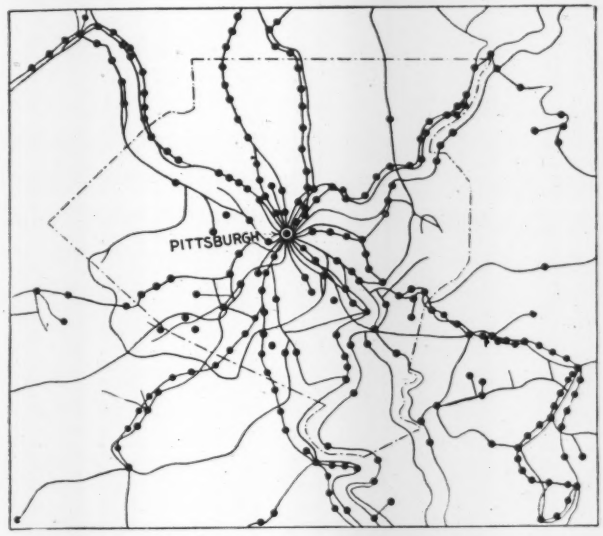


FIG. 2—RAILWAY STATION MAP INDICATING SUBURBAN SETTLEMENT

Care was taken to get as easy grades as possible regardless of turns and curves. Macadam was the roadway material and it was generally only 12 or 14 ft. wide. The roads were all radial, with Pittsburgh as the center. They were all local roads into the big city. Cross-county or belt connecting roads were scarcely considered. Contemporaneous with the expression of highway consciousness in 1894, there began an era of business development. The county real estate valuation increased from $432,549,830 in 1895 to a little over a billion dollars in five years and to $1,746,378,570 in 1926.

In this same period industry and population began to spread out from the focal center at the junction of the rivers along the north bank of the Ohio and along both banks of the Allegheny and the Monongahela. Residence communities grew up in the hills back of the rivers. The county steam and electric station map Fig. 2 indicates the intensive settlement. Along with this came the motor vehicle. Allegheny County last year had 194,500 registered cars and in Pennsylvania there were 1,275,000 of which perhaps 200,000 were commercial vehicles. Of these, too, Allegheny County has probably more than its numerical proportion and owing to the nature of the county's industries its share of heavy trucks is particularly large. Traffic changed. Through traffic originated. Intercounty traffic developed. Intra-county traffic evidenced the need of connections not involving a route through Pittsburgh which had become the focus of an enormous concentration as shown by the transportation survey map Fig. 3. The system of radial and local roads laid out for a traffic of horse-drawn vehicles was obviously a poor setup to meet the changed conditions.

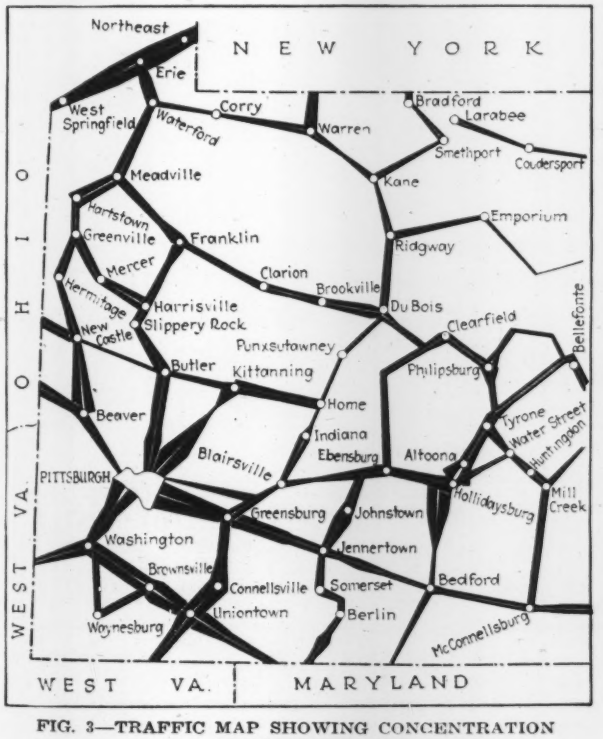


FIG. 3—TRAFFIC MAP SHOWING CONCENTRATION AT PITTSBURGH

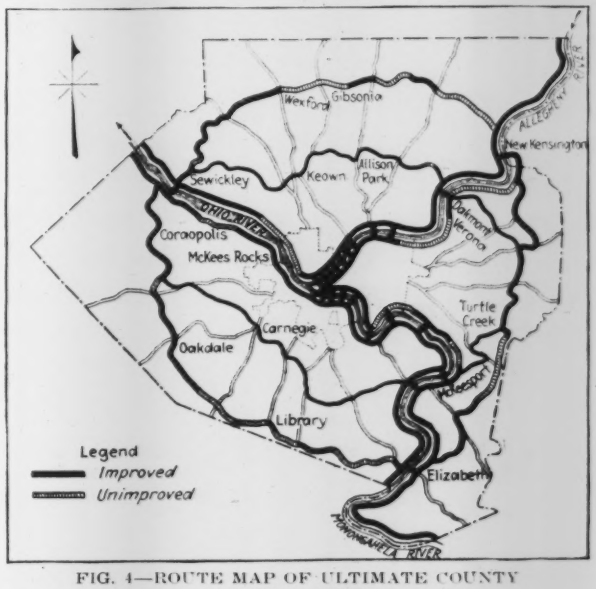


FIG. 4—ROUTE MAP OF ULTIMATE COUNTY HIGHWAY SYSTEM

All along as the changes described had come about there had of course been improvement of the roads, but the old order of road transportation routes was not fitted to the new conditions. A broader plan of development had to be devised. The task assumed several phases: (1) The county organization had to be centralized and extended to perform increased duties; (2) funds had to be provided for extensive new construction and improvement; (3) a comprehensive county road system plan had to be settled on; and (4) problems of engineering design and construction had to be worked out.

Reorganization and Financing—The new setup was undertaken in 1924. Big problems confronted the county. Besides planning, locating and constructing a system of roads there was a large amount of bridge work including major bridges across the main rivers. Previously the bureau of roads under the road commissioner and the bureau of bridges under the county engineer had been separate organizations. In January, 1924, the county commissioners formed the Department of Public Works of Allegheny County and appointed Norman F.

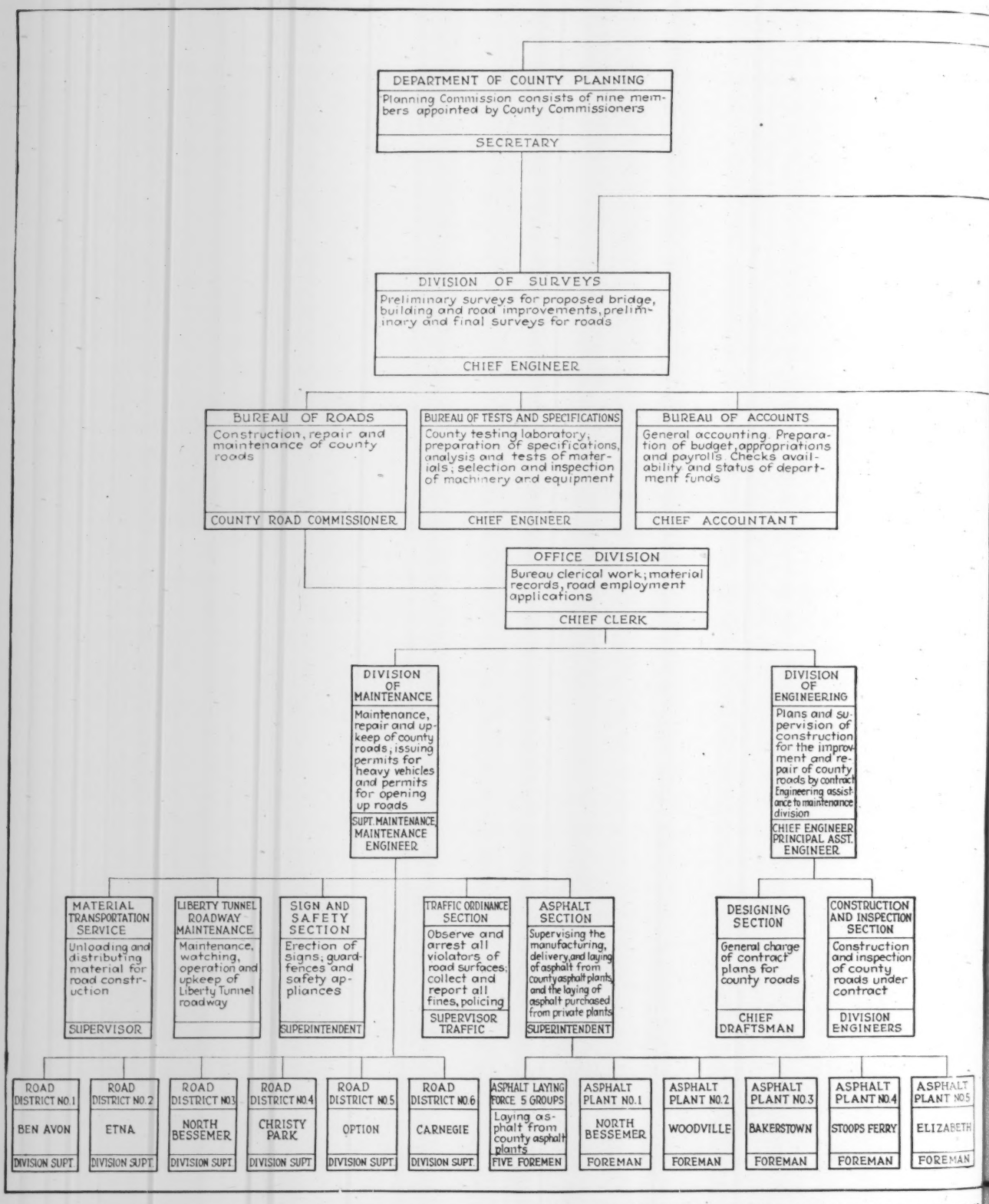
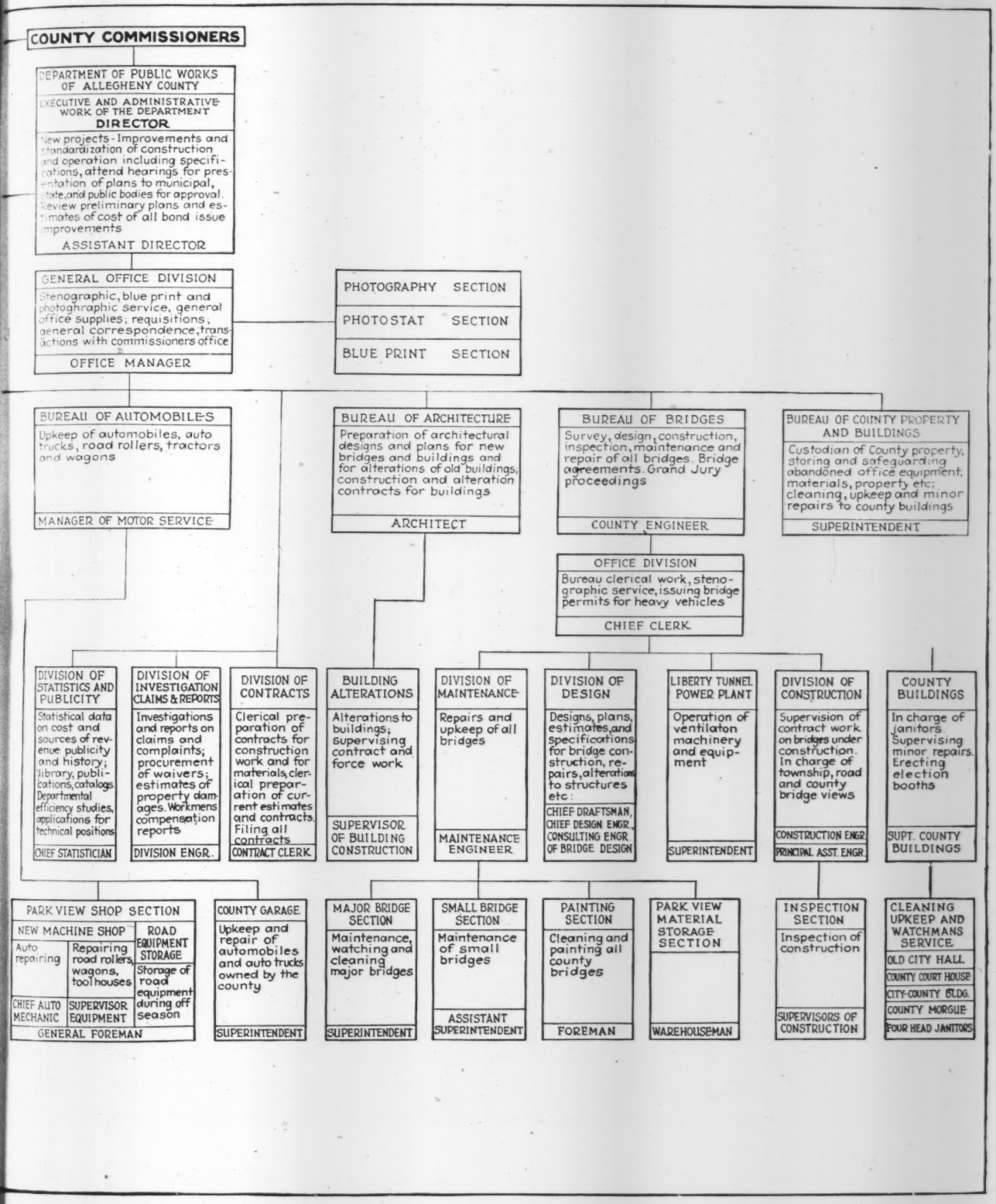

DEPARTMENT OF COUNTY PLANNING
Planning Commission consists of nine members appointed by County Commissioners
SECRETARY
DIVISION OF SURVEYS
Preliminary surveys for proposed bridge, building and road improvements, preliminary and final surveys for roads
CHIEF ENGINEER
BUREAU OF ROADS
Construction, repair and maintenance of county roads
COUNTY ROAD COMMISSIONER
BUREAU OF TESTS AND SPECIFICATIONS
County testing laboratory; preparation of specifications, analysis and tests of materials; selection and inspection of machinery and equipment
CHIEF ENGINEER
BUREAU OF ACCOUNTS
General accounting. Preparation of budget, appropriations and payrolls. Checks availability and status of department funds
CHIEF ACCOUNTANT
OFFICE DIVISION
Bureau clerical work; material records, road employment applications
CHIEF CLERK
DIVISION OF MAINTENANCE
Maintenance, repair and upkeep of county roads; issuing permits for heavy vehicles and permits for opening up roads
SUPT. MAINTENANCE MAINTENANCE ENGINEER
DIVISION OF ENGINEERING
Plans and supervision of construction for the improvment and repair of county roads by contract Engineering assistance to maintenance division
CHIEF ENGINEER PRINCIPAL ASST. ENGINEER
MATERIAL TRANSPORTATION SERVICE
Unloading and distributing material for road construction
SUPERVISOR
LIBERTY TUNNEL ROADWAY MAINTENANCE
Maintenance, watching, operation and upkeep of Liberty Tunnel roadway
SIGN AND SAFETY SECTION
Erection of signs; guardfences and safety appliances
SUPERINTENDENT
TRAFFIC ORDINANCE SECTION
Observe and arrest all violators of road surfaces; collect and report all fines, policing
SUPERVISOR TRAFFIC
ASPHALT SECTION
Supervising the manufacturing, delivery and laying of asphalt from county asphalt plants, and the laying of asphalt purchased from private plants
SUPERINTENDENT
DESIGNING SECTION
General charge of contract plans for county roads
CHIEF DRAFTSMAN
CONSTRUCTION AND INSPECTION SECTION
Construction and inspection of county roads under contract
DIVISION ENGINEERS
ROAD DISTRICT NO.1 BEN AVON DIVISION SUPT.
ROAD DISTRICT NO.2 ETNA DIVISION SUPT.
ROAD DISTRICT NO.3 NORTH BESSEMER DIVISION SUPT.
ROAD DISTRICT NO.4 CHRISTY PARK DIVISION SUPT.
ROAD DISTRICT NO.5 OPTION DIVISION SUPT.
ROAD DISTRICT NO.6 CARNEGIE DIVISION SUPT.
ASPHALT LAYING FORCE 5 GROUPS Laying asphalt from county asphalt plants FIVE FOREMEN
ASPHALT PLANT NO.1 NORTH BESSEMER FOREMAN
ASPHALT PLANT NO.2 WOODVILLE FOREMAN
ASPHALT PLANT NO.3 BAKERSTOWN FOREMAN
ASPHALT PLANT NO.4 STOOPS FERRY FOREMAN
ASPHALT PLANT NO.5 ELIZABETH FOREMAN

FIG. 5—DEPARTMENT OF PUBLIC WORKS ORGANIZATION

Brown its first director. Mr. Brown consolidated within the department the bureau of roads and the bureau of bridges and created an additional bureau of architecture, tests and specifications, accounts and automobiles. He also formed several service divisions such as investigations, statistics and publicity and contracts. The finally


COUNTY COMMISSIONERS
DEPARTMENT OF PUBLIC WORKS OF ALLEGHENY COUNTY
EXECUTIVE AND ADMINISTRATIVE WORK OF THE DEPARTMENT
DIRECTOR
New projects - Improvements and standardization of construction and operation including specifications, attend hearings for presentation of plans to municipal, state, and public bodies for approval. Review preliminary plans and estimates of cost of all bond issue improvements
ASSISTANT DIRECTOR
GENERAL OFFICE DIVISION
Stenographic, blue print and photographic service, general office supplies; requisitions; general correspondence, transactions with commissioners office
OFFICE MANAGER
PHOTOGRAPHY SECTION
PHOTOSTAT SECTION
BLUE PRINT SECTION
BUREAU OF AUTOMOBILES
Upkeep of automobiles, auto trucks, road rollers, tractors and wagons
MANAGER OF MOTOR SERVICE
BUREAU OF ARCHITECTURE
Preparation of architectural designs and plans for new bridges and buildings and for alterations of old buildings, construction and alteration contracts for buildings
ARCHITECT
BUREAU OF BRIDGES
Survey, design, construction, inspection, maintenance and repair of all bridges. Bridge agreements. Grand Jury proceedings
COUNTY ENGINEER
BUREAU OF COUNTY PROPERTY AND BUILDINGS
Custodian of County property, storing and safeguarding abandoned office equipment, materials, property etc; cleaning, upkeep and minor repairs to county buildings
SUPERINTENDENT
OFFICE DIVISION
Bureau clerical work, stenographic service, issuing bridge permits for heavy vehicles
CHIEF CLERK
DIVISION OF STATISTICS AND PUBLICITY
Statistical data on cost and sources of revenue publicity and history; library, publications, catalogs. Departmental efficiency studies, applications for technical positions
CHIEF STATISTICIAN
DIVISION OF INVESTIGATION CLAIMS & REPORTS
Investigations and reports on claims and complaints; procurement of waivers; estimates of property damages. Workmens compensation reports
DIVISION ENGR.
DIVISION OF CONTRACTS
Clerical preparation of contracts for construction work and for materials, clerical preparation of current estimates and contracts. Filing all contracts
CONTRACT CLERK
BUILDING ALTERATIONS
Alterations to buildings; supervising contract and force work
SUPERVISOR OF BUILDING CONSTRUCTION
DIVISION OF MAINTENANCE
Repairs and upkeep of all bridges
MAINTENANCE ENGINEER
DIVISION OF DESIGN
Designs, plans, estimates, and specifications for bridge construction, repairs, alterations to structures etc:
CHIEF DRAFTSMAN
CHIEF DESIGN ENGR.
CONSULTING ENGR OF BRIDGE DESIGN
LIBERTY TUNNEL POWER PLANT
Operation of ventilaton machinery and equipment
SUPERINTENDENT
DIVISION OF CONSTRUCTION
Supervision of contract work on bridges under construction. In charge of township, road and county bridge views
CONSTRUCTION ENGR.
PRINCIPAL ASST. ENGR.
COUNTY BUILDINGS
In charge of janitors. Supervising minor repairs. Erecting election booths
SUPT. COUNTY BUILDINGS
PARK VIEW SHOP SECTION
NEW MACHINE SHOP
Auto repairing
Repairing road rollers, wagons, tool houses
CHIEF AUTO MECHANIC
SUPERVISOR EQUIPMENT
ROAD EQUIPMENT STORAGE
Storage of road equipment during off season
GENERAL FOREMAN
COUNTY GARAGE
Upkeep and repair of automobiles and auto trucks owned by the county
SUPERINTENDENT
MAJOR BRIDGE SECTION
Maintenance, watching and cleaning major bridges
SUPERINTENDENT
SMALL BRIDGE SECTION
Maintenance of small bridges
ASSISTANT SUPERINTENDENT
PAINTING SECTION
Cleaning and painting all county bridges
FOREMAN
PARK VIEW MATERIAL STORAGE SECTION
WAREHOUSEMAN
INSPECTION SECTION
Inspection of construction
SUPERVISORS OF CONSTRUCTION
CLEANING UPKEEP AND WATCHMANS SERVICE
OLD CITY HALL
COUNTY COURT HOUSE
CITY-COUNTY BLDG.
COUNTY MORGUE
FOUR HEAD JANITORS

CHART, ALLEGHENY COUNTY, PENNSYLVANIA

fully developed organization is shown by Fig. 5. In brief the purpose was to create a department adequate in division of work and administrative and technical personnel to design and supervise the construction of a costly system of roads and bridges, to budget and keep account of large expenditures, to make and record tests

and to draft contracts and specifications—a self-contained organization for public works. The details of department organization may be passed except to observe that technical competency was sought in every office, so that complete independence in engineering design and direction might be had by the county authorities. How fully this has been attained is demonstrated by the complete engineering within the department of the great river bridges recently completed and now under construction.

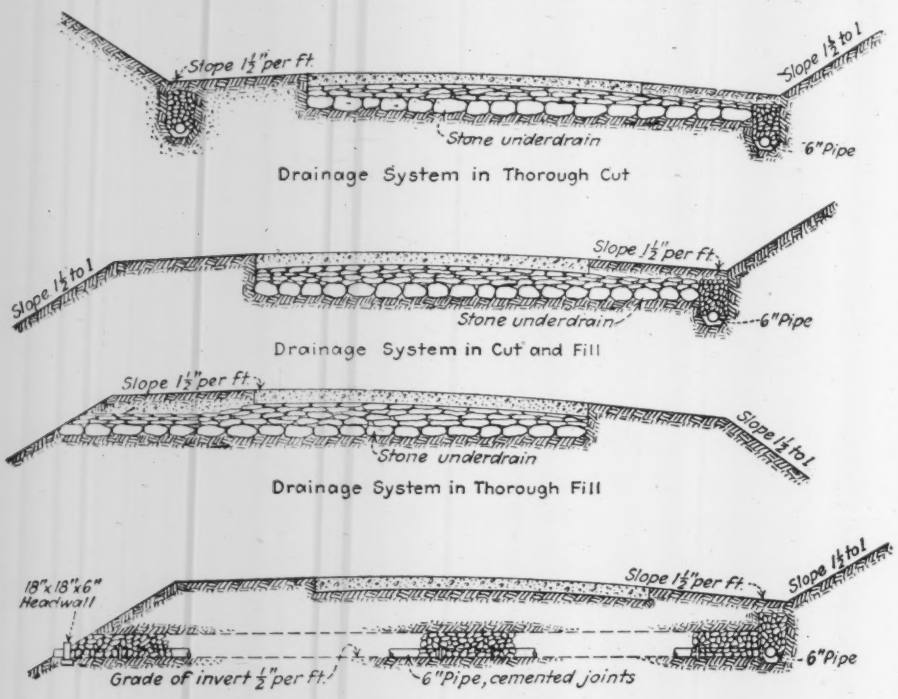


FIG. 6—ROADWAY DRAINAGE STANDARDS

With the creation of the new department of public works the county commissioners submitted to the people on April 22, 1924, a $29,000,000 bond issue distributed approximately $8,000,000 for roads, $18,500,000 for bridges, $1,500,000 for a tunnel and $1,000,000 for a new county office building. The people approved this bond issue by a large majority. The money as well as the vote of confidence justified the county officials in going ahead under the new organization and in their expressed policy of wise and economic road location and durable road construction to outlast the life of the bonds.

System Plan and Location—A system plan was the first consideration. In developing this there were a number of things which had to be kept in mind. First, there was the existing road system. It was essential that as much of this should be conserved as would work into a well-conceived, economic system plan. Second, there was the new setup of traffic conditions. Chief among these was the requirement that, as fully as it could be done, traffic should be bypassed around Pittsburgh instead of carried through the city. Third, there was the topography. The natural routes which it offered and the barriers to routes demanded the most serious attention. Fourth, there was cost. The immensity of the program made any available and prospective road building fund inadequate without the most rigid budgeting and efficiency of expenditure.

Keeping these conditions before them the county commissioners undertook as a first step to outline an ultimate system plan. It was not the thought that the ultimate system plan would remain invariable or would represent finality in county highway development. In a growing community, it was realized, a highway system was never completed but was always subject to additions and alterations. A pre-established road plan offers, however, the advantages that the additions and alterations of the future are not wasteful or uneconomic. They do not cause the abandonment or scrapping of past work and effort; they simply alter past work in an economic way so that it fulfills increased demands. In outlining, then, an ultimate system plan the director of public works co-operated with the county planning commission. The plan worked out together is indicated by Fig. 4. It consists of three classes of roads: (1) Riverside highways, following with unbroken continuity the river banks and bonded together across-river by bridges; (2) radial highways reaching out spokelike from Pittsburgh to the county line; and (3) circuit highways completely encircling the county's interior and connecting the radial roads. Incidentally a skeleton of the riverside and radial road plan existed in the old road system.

FIG. 7—TYPE OF LARGE DRAINAGE STRUCTURE

Considering the system-plan specifically as shown by Fig. 4 it will be noted that the inner circuit road is not a completely separate circuit or belt. The topography rendered north and south lines so costly that they were left out until at some future time traffic may require the expenditure. With this omission there are six riverbank

boulevards connecting directly the city of Pittsburgh and the score of industrial suburbs grown up along the rivers, a full score of radial roads fanning out from the big city to the county line, and two belt highways intersecting and joining together the river boulevards and the radial roads.

FIG. 8—BURLAP COVERING IN CURING CONCRETE ROADS

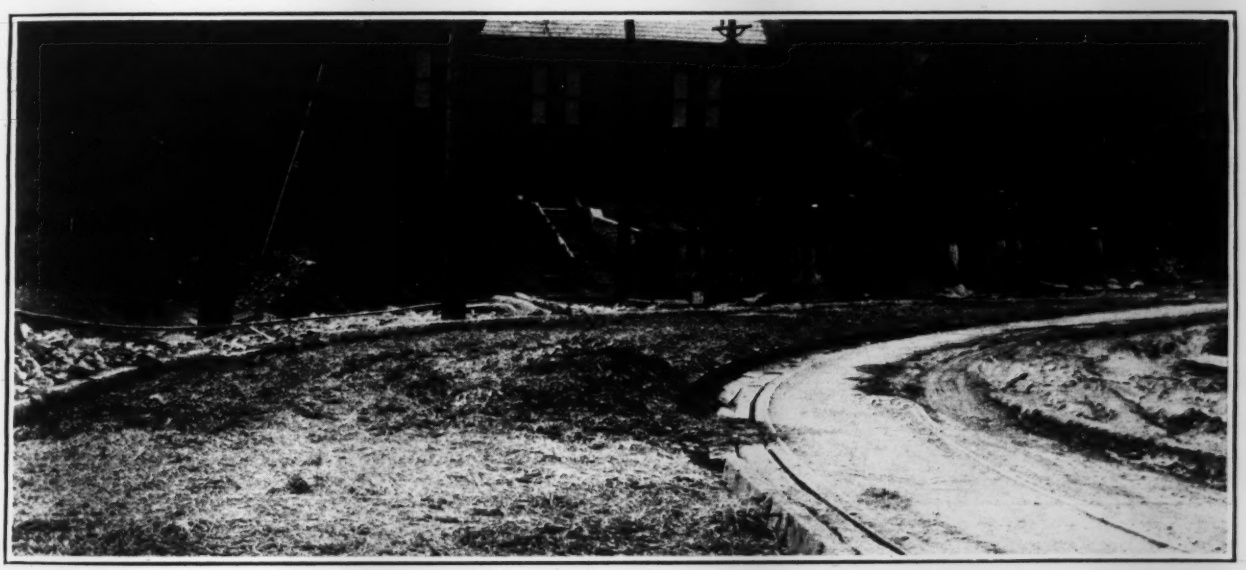


FIG. 9—STRAW COVERING IN CURING CONCRETE ROADS

With the rugged topography, route location despite the well designed system plan was a difficult problem. The old roads followed serpentine routes, and where they came into the new system plan, about all the route changes possible were flattening grades and curves. Where new locations had to be found they must be searched out along side hills broken by many ravines. Here, too, there was little freedom of line choice. The engineers must go where they could among the bluffs and gorges. They had virtually to forget tangents. A common assertion is that there is not a mile of tangent highway in Allegheny County. A succession of side-hill curves and of crossings of intersecting ravines is the highway route characteristic.

Construction Plan—With conditions as described construction costs necessarily would be high. As a matter of fact the new roads have run in cost from $50,000 per mile to $200,000 of which amounts grading makes up $20,000 and $148,000, respectively. This made careful budgeting essential. With the $8,000,000 road improvement bonds the following division of expenditure was planned:

New road construction	$4,500,000
Joint road improvement	1,088,000
Reconstruction and widening	1,162,000
Grade crossing elimination	800,000
Eliminating dangerous curves	500,000
Erecting safety barriers	400,000
Total	$8,000,000

Over one-third of the money, it will be observed, has been allotted for traffic protection and for conserving old road structure by enlargement to meet modern traffic conditions.

In developing the construction plan the department officials had also these things to keep in mind: (1) To conserve the old roads by embodying them in the new plan wherever the two coincided, and by careful upkeep;

(2) to concentrate work on the most needed routes; (3) to strive for continuity of route construction instead of carrying on scattered disconnected operations.

Construction Practice—With so many differences of condition, road design and construction details are too many to enumerate. Only ruling practices will be indicated.

In location grades are kept at a maximum of 10 per cent for secondary roads and of 8 per cent for primary roads; the minimum for drainage is 0.5 per cent. Curvature is given more particular attention. The purpose is to get the greatest radius of curve obtainable to eliminate curve widening and superelevation. It is considered that curves having 1,000-ft. or greater radius require no superelevation and that curves of 600-ft. or greater radius require no widening. The absolute minimum radius is put at 300 ft., but many roads have been built with curves of 600-ft. minimum radius. The superelevation of curves of less than 1,000-ft. radius is based on a vehicle speed of 40 miles an hour. In widening curves of less than 600-ft. radius, the addition is made on the inside, half widening at point of curve and point of tangent and full widening for the greater part of the length. All short-radius horizontal curves are daylighted. The maximum length of parabolic curve is 200 ft. The length at the crown of a hill is determined on the basis of a minimum vision distance of 500 ft.

In roadbed design the shoulders are given a slope of 1½ in. a foot so that the entire berm width acts as a ditch. When water has to be carried long distances concrete gutters are built. Over filled ground the side gutters are relieved by lateral slope gutters of concrete or masonry. There are also numerous cross-culverts to relieve the side ditches of surface water. Stone underdrains are used to intercept capillary water. There is also subdrainage to a depth of 3 ft. or more to intercept ground water at the edge of the berm and parallel to the paving. In swampy ground broken stone and pipe drains are placed in slip territory on hillsides adjacent to the road. To prevent saturation of the fill, ditches are dug beyond the edges and also ditches are dug to intercept water above slip territory. The toes of fills bordering on streams are protected by slope walls.

In particular great attention is given to roadbed drainage. The sidehill location which is common makes this essential. The subdrainage is notable for its extent and its variety of purpose as shown by Fig. 6. These are standards. Drain location and intervals are determined by the engineers in the survey or on the ground and so far as possible are delineated on the contract plan. The larger types of drainage structure are indicated by Fig. 7.

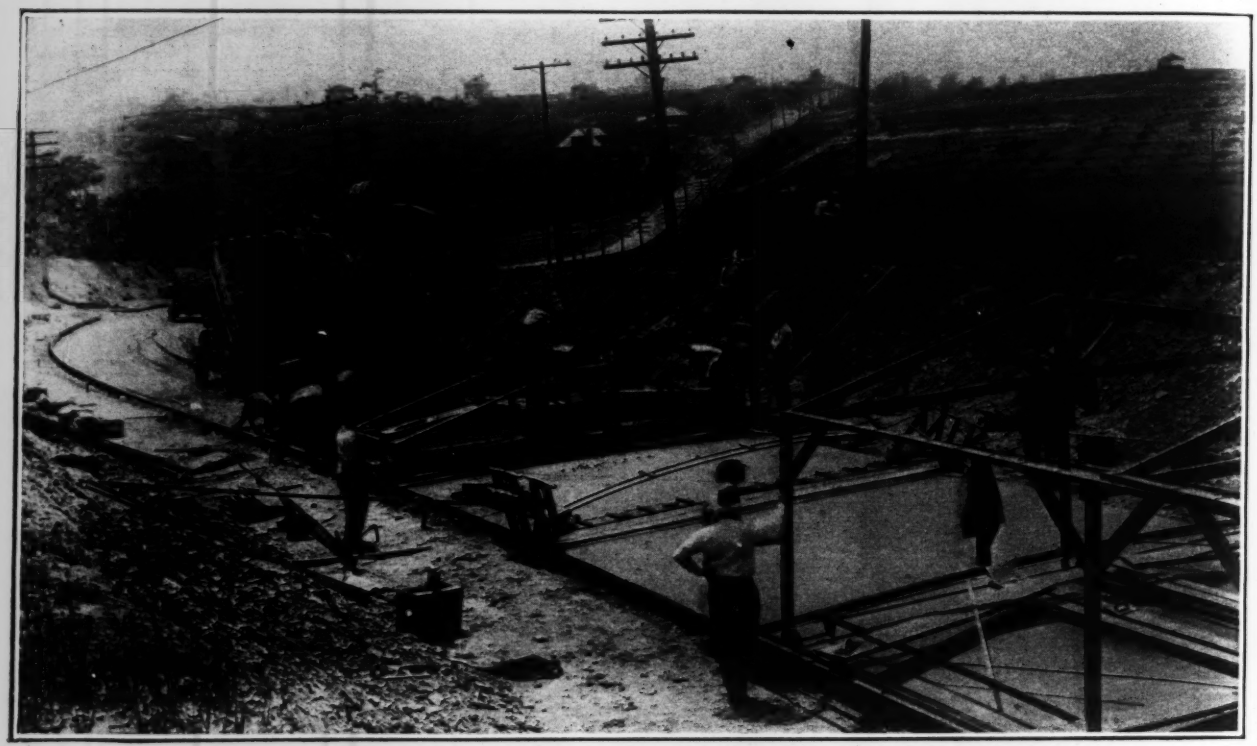


FIG. 10—REPRESENTATIVE CONCRETE PAVING OUTFIT

Largely three types of pavement are used: Reinforced concrete, brick on concrete base and asphaltic concrete on concrete base.

Reinforced-concrete pavement is built 18 ft. and 27 ft. wide with a steel center joint doweled every 5 ft. The standard section is 9-7-9 in. with transverse joints every 50 ft. The reinforcement consists of four bars around the edges of each panel and four diagonal corner bars. A 1:2:3 mix is used with stone, gravel or slag aggregate depending upon proximity of road to source of supply. The concrete is cured by burlap, Fig. 8, and straw, Fig. 9, wetted for nine days and left on the slab for nine more days. After removing the straw the road is exposed three days before traffic is turned onto it. Construction equipment and methods, Fig. 10, follow usual good practice.

The concrete base for brick pavement is 8 in. of 1:2:4

concrete using the same aggregates as are used for concrete roads. Both 3-in. and 4-in. brick are used, laid on a ¾- to 1-in. cement sand cushion, with a bituminous joint filler. The brick pavements are 18, 27 and 36 ft. wide.

FIG. 11—SIDEHILL CUT AND RETAINING WALL

Virtually the same construction is followed for asphaltic concrete wearing surface, omitting of course the cushion. The black top is 2 in. thick. All base concrete is cured as is concrete pavement. In all concrete the contractor is permitted to use 2 per cent of calcium chloride and in

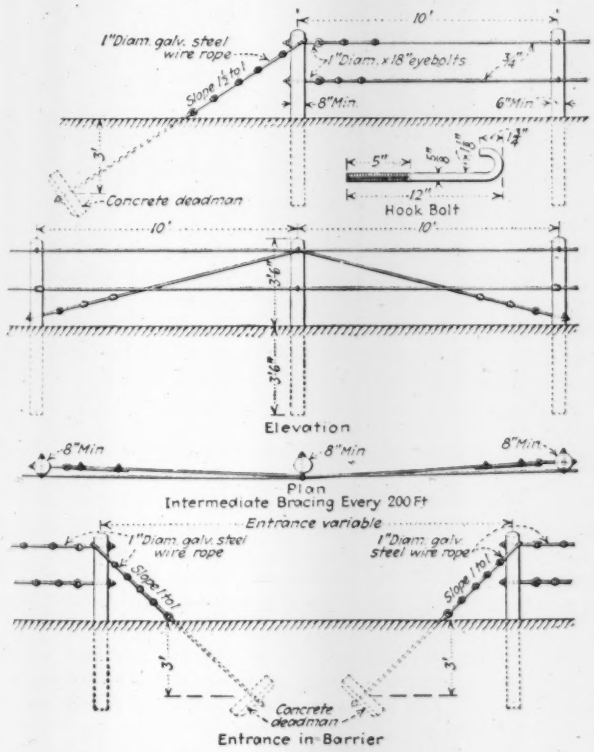


FIG. 12—STANDARD WIRE ROPE GUARD RAIL

all pavement the time of opening to traffic is reduced when results of beam tests for modulus of rupture permit.

Owing to the common side-hill location and many curves there has to be a very large use of retaining wall and guard rail. A typical retaining wall location is shown by Fig. 11. The wire rope guard rail has been adopted as standard, basing the choice on the tests made by the Pennsylvania highway department some three years ago in co-operation with the Bureau of Public Roads. The design as shown by Fig. 12 calls for a 1-in. top cable and a hook-bolt post attachment which does away with boring the post.

Construction Control—The organization chart Fig. 5 gives a very clear indication of the sequence and division of authority through which the control of construction and maintenance is exercised. In general the usual means—plans and specifications, progress records, testing and inspection—are employed and virtually all the remark required is that they are employed in rather more elaborate form than is common. This is true in particular of the keeping of progress records and of materials testing. It is not in technical and management details, however, that the Allegheny County road work commands most consideration.

Conclusion—Under the difficult conditions of topography and geography, the great significance of the county's activities is in the centralization of all control in a department of public works and in the adoption of an ultimate system plan to which all work be it fast or slow will contribute. It is in the broad grasp of its task that Allegheny County is notable among counties which are doing extraordinary road building, and in its self-sufficient organization and personnel. For example, previously all the main river bridges, which of necessity are structures of major size, were engineered by outside designers, but since the present organization has been completed they have been designed and their construction supervised by the county engineers. An important accomplishment has been the department's selling of itself to the county. It now stands in a position where its recommendations and requests command quick compliance by the people.

Effects of Town-Lot Oil Well Drilling

In the Alamitos Heights section of the Seal Beach field, one of California's recent prolific oil fields, "town-lot" drilling has been practiced in an aggravated form. In the *Standard Oil Bulletin* for July, 1927, published by the Standard Oil Co. of California, some of the possible effects of this practice are noted. "There is one area of 25 acres in what is now the main portion of the field on which 65 wells were drilled. It is likely that the total cost of these wells amounted to $5,200,000. In addition, royalty, probably averaging one-sixth of the oil recovered, is paid by the producer to the property-owner. Estimating the value of the oil recovered at 90c. per barrel—and a good deal of Alamitos production sold for much less—it would require a production of 6,935,000 bbl. of petroleum to pay expenses and royalties only. For the 25-acre area this would mean a production of 277,400 bbl. per acre. This would be a high rate. Some of the finest oil lands in California have failed to come anywhere near the figure. Elsewhere in the field conditions are even less favorable. All told, unless new oil deposits are found, Alamitos Heights will prove a financial misfortune. Certainly the oil so far discovered in that area could be recovered with far fewer wells and a much smaller outlay of money."

Flood Protection Work Started at Beardstown, Ill.

Concrete Wall on River Front Flanked by Earth Levees Extending Inland to Enclose Oft-Submerged City

IN THE periodical floods of the Illinois River, one of the worst sufferers has been the city of Beardstown, situated nine miles below the mouth of the Sangamon River and having a population of about 8,000. Here the valley of the Illinois River is about six miles wide, but for a distance of 70 miles below Beardstown the greater part of the bottom lands have been reclaimed by levee construction. Thus the flood waters are now confined to a definite channel, which has a width of only 1,500 ft. for some distance below the city.

As a result the flood of 1922 reached El. 452.2 ft. (Memphis datum), while the flood of 1904, with practically the same volume, had reached only 446.8. In the great flood of 1926, a maximum El. 453.7 ft. was reached, 26.34 ft. on the Beardstown gage, or 1½ ft. above any previous record. Practically the entire city was submerged. Twice during the 1927 floods the water reached gage heights of 25 and 25.2 ft., equivalent to El. 452.36 and 452.56, Memphis datum.

Although the city itself has been partly surrounded by the levees of adjacent drainage districts and by railway embankments, these have not been sufficient protection, and as the levees did not extend to the higher ground behind the city they permitted back-water to enter from the rear. In 1923, the legislature made an appropriation of $350,000 for building, raising and improving levees to protect the city, this levee system to have an elevation of 455 ft., Memphis gage.

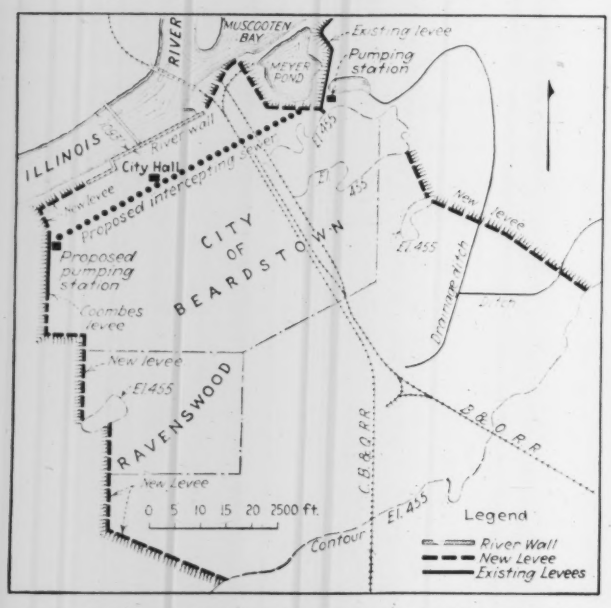


FIG. 1—FLOOD PROTECTION FOR BEARDSTOWN, ILL.

Four different plans were studied by the State Division of Waterways and in 1926 one of these plans, Fig. 1, was adopted by agreement with the city. According to this adopted plan, which is now under contract, a concrete bulkhead or river-front wall will be built along Main and Water Sts. for a distance of about 2,500 ft. From each end of this wall an earth levee will extend inland to the 457-ft. contour line.

In typical design, the reinforced-concrete wall, Fig. 2, will have a footing width of 12 ft. and a vertical face with a maximum height of 23 ft. For about 9 ft. from the top it will have a uniform thickness of 3 ft., and will then slope back at 1 on 2 to the footing, as shown. The footing will be at El. 432 and will be founded on two rows of wood piles driven into the deep bed of sand and gravel. Wood sheetpiling will be used if conditions require it. Backfilling behind the wall will be 7 ft. wide at top, with a slope of about 1 on 1½ or such slope as the fill material will take. For part of the distance a street will be carried on the backfill. Here the wall, only about 10 ft. high, has a back slope of 1 on 3 from the top, as shown.

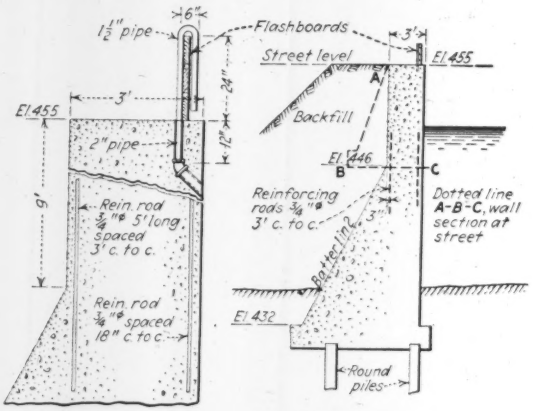


FIG. 2—RIVER-FRONT WALL WITH FLASHBOARDS.

While the crest of the wall is at El. 455, the exceptional height of the 1926 flood (El. 453.7), which established a new record, led the engineers to supplement the original design by providing sockets in the top of the wall to receive standards supporting flashboards 2 ft. high. These boards will raise the crest or flood protection height to 4.44 ft. above the 1927 flood or 3.3 ft. above the record flood of 1926. The sockets, 5 ft. apart, will be of 2-in. pipe, 12 in. deep, and will lead out to the back of the wall as drains. The standards will be of 1½-in. pipe, bent in U-shape, as shown, to hold the 2-in. flashboards.

The earth levees will have their crests at a gage height of 31.75 ft. (El. 459), or 2 ft. above the tops of the flashboards on the river wall. They will range in height up to 20 ft., with a uniform top width of 10 ft. and slopes of 1 on 3. Where existing levees are to be raised and strengthened, the adopted section will be set back of the old levee so as to give a direct slope of 1 on 3 from the crest to the toe of borrow ditch on the water side. In construction, the ground surface is to be cleared and plowed, or stepped when necessary on sloping ground. The fill will then be placed in layers, spread, wetted and compacted by rolling or otherwise. The surfaces of the levees and backfills will be dressed to prescribed slopes and finished with a layer of top soil. Cement for the wall will be furnished by the state.

As the new levees will enclose a drainage area of 3 square miles on the higher ground behind the city, provision will be made by the city of Beardstown to handle

the runoff from this area by an electrically operated pumping plant.

No sewers or sewage pumping plants are provided for in the state's plans, nor do these plans provide for maintenance of the levees or operation of the drainage pumping plant, since such works and expenses should be taken care of by the city. As the city, under its debt limit, is unable to provide funds for the necessary works, a sanitary district embracing the entire protected area is being created, in order that adequate funds can be made available to carry out the projected sewerage works. A proposed main intercepting sewer is shown in Fig. 1.

Contracts were let by the state on July 1, 1927, as follows: James O. Heyworth Co., Chicago, $174,200 for reinforced-concrete wall, 10,000 cu.yd.; McWilliams Dredging Co., Chicago, $138,750 for the earth levees, 450,000 cu.yd. Design and construction are under the direction of the State Division of Waterways, L. D. Cornish, assistant chief engineer, being in full charge, with Allan Millard, of the local engineering firm of Godell & Millard, acting as resident engineer.

Structural Welding of Gas Plant, Melbourne, Australia

Six Years of Successful Construction of Welded Structural Steelwork—Design, Inspection and Checks on Performance

DURING the past six years the Metropolitan Gas Co., of Melbourne, N.S.W., has fabricated and erected over 10,000 tons of structural steel work by electric welding, including five gasholders of 250 to 760 tons each, two retort houses of about 500 tons each, and much miscellaneous plant.

H. E. Grove, superintendent of construction for the company, in summarizing this work in the *Journal* of the American Welding Society, explained that the company began its own fabrication work because of the difficulty of supply by gas plant manufacturers and fabricators and has continued because it finds its own work to be much cheaper than contract work. At first riveting was used, and the change from riveting to welding was made only gradually as the necessary organization was built up and test and experience data obtained to guide in sound construction. Mr. Grove said:

"Many difficulties were encountered, as is common in the introduction of any new process. We were faced with complete lack of physical data on the strength of welds, absence of trained welders, and abysmal ignorance of the subject ourselves, but we instinctively felt that the process offered great possibilities. One difficulty which nearly defeated us in the early stages was the distortion of the material due to the intense local heat, especially distortion in large members such as the sheeting of gasholders."

Designing for Welding—Designs and drawings are carried out with the same fullness of detail as for riveted work. All welds are indicated not only as to location but also as to size and amount of electrode to be used, and number of runs (whether the weld metal is to be deposited in one layer or more). Thus, a weld that is to be made in a double run, using for the first one a No. 10 electrode at the rate of 5½ in. per stick and for the second a No. 8 electrode at the rate of 4 in. per stick, would be noted as:

$$\frac{10/5\frac{1}{2}\text{ in.}}{8/4\text{ in.}}$$

The rate of electrode consumption specified fixes the size of the weld fillet. All fillets are 45 deg. For the thinner material, up to $\frac{3}{16}$ in., all welds are full fillet welds, but for thicker material the electrode size is selected so as to give smaller welds, as required by the strength of the joint needed.

Prints of the shop drawings are made for shop foreman, welding foreman, and field erector, and the welding is marked in red for shop welding and green for field welding. With them go instruction sheets and bills of material. In the welding bay the work is first assembled by tack welding, with a minimum use of assembly bolts, and then is fully welded up, under supervision of the welding foreman. As to this phase of the work and the verification of quality of weld Mr. Grove says:

"The welding foreman is directly responsible for the quality of the work done under his supervision, and nothing is left to his discretion; he simply carries out the instructions on the drawing. In the field the same procedure is adopted, the field erector taking full responsibility, at the same time having an assistant welding foreman under his control. Inspection of the welding does not end with the supervision mentioned. There are checks and counterchecks, especially as to the amount of metal deposited.

"To insure good welding, piecework is out of the question, every inducement being given to insure quality rather than quantity. As far as possible individual welders' initials are branded or painted on their work. It has been surprising to find how far visual inspection by an experienced man is an indication of the quality of the work, and it has been found when cutting out inferior work that the quality has been better than was anticipated. It is well nigh impossible in this organization for bad work to remain undetected."

Performance and Problems—The standard electrodes used are No. 10, in 18-in. length (16¾ in. usable). A number of other sizes are kept in stock, but most of them are only rarely used. Each welder reports on his time card the job number, time of starting, class of weld, number of type of electrodes issued to him, number of electrodes remaining, time of finishing job, amperage, machine number, and any remarks such as reasons for delay. The foreman reports the length welded. From these reports the office computes every day the figures for amount of electrode metal deposited in the various welds, and thus obtains a direct check on performance.

The following remarks are of special interest:

"It must be remembered that distortion is the bugbear of the process, and the designer in specifying welding must try to reduce the concentration of heat throughout the job. By this and by the judicious stressing of the materials prior to and during welding, distortion and locked up stresses may be greatly reduced.

"Our practice wherever possible is to employ the same amount of lap that would be called for in a similar riveted joint. This condition should be observed, to lessen the effect of bending.

"Plates are hardly ever sheared. Excess of metal is

left in the overlap, so that generally the laps in our work exceed those of similar riveted joints. The writer would mention a steel tank 102 ft. in diameter by 17 ft. 6 in. deep that has lately been built. The tank is four tiers high, the lower being $\frac{3}{8}$ in. thick, and one $\frac{5}{16}$ in., and two $\frac{1}{4}$ in. thick. The $\frac{3}{8}$-in. plates were rolled to the required curvature, this being the only operation performed by the shop. At erection the absence of holes did not present any difficulty; new methods were quickly devised and the erection went forward with at least as much ease as in the case of a riveted tank.

In gasholder welding as developed, in place of dimensions being given to and worked from rivet centers, our practice is to work from plate edge to plate edge. Horizontally the leading edge of one plate is selected as datum, and from that edge the dimensions are given to the respective edges of the remaining plates. Vertically, the procedure is similar, datum being at the base. It is certainly surprising how quickly a tank can be erected and welded and with what certainty the tightness of the joints may be guaranteed.

Economies and advantages as further brought out in the summary are:

"Comparing a welded tank to a first-class riveted tank, the time for calking the latter is about the time required for welding. With careful design the savings can be considerable. The design can provide for 100 per cent efficiency joints with a saving of material; marking off, punching and shearing can be eliminated; erection work simplified, and calking is not required.

"No criterion of the relative cost of the finished structure is furnished by a comparison of the cost per foot of riveting and of welding. It is even conceivable that riveting as a single operation might be cheaper than a similar length of welding, but when all the operations from the drafting board to the finished structure are considered, the case is far otherwise. The relative cost of electrodes is of little importance, and at the expense of quality no case can be made for saving in this direction. It would make but little difference in the cost of a typical framed structure if electrodes were given free."

REPRESENTATIVE RESULTS OF FAILURE TESTS OF WELDED JOINTS, METROPOLITAN GAS CO. OF MELBOURNE

Thickness of Metal	Type and Size of Weld	Ultimate Strength per Lin. In. of Weld
Shear Longitudinal to Weld		
$\frac{5}{16}$	No. 10	5,100–7,500
$\frac{3}{8}$–$\frac{3}{4}$	No. 10–No. 12	3,100–4,500
$\frac{1}{2}$	No. 10/5–No. 8/5.5	10,800–11,800
$\frac{1}{2}$	No. 10/5	7,800
Shear Transverse to Weld		
$\frac{5}{16}$	No. 10	4,100
$\frac{1}{2}$	No. 8/3.36	8,600
3/8–1.2	No. 10/4.66–No. 10/4	9,000–10,300
$\frac{1}{2}$	No. 10/5	10,600
$\frac{1}{2}$	No. 10/5–No. 8/5½	15,500
$\frac{5}{16}$–$\frac{1}{2}$	No. 10/6	9,000–10,300
$\frac{5}{16}$–$\frac{1}{2}$	No. 10/6–No. 10/5	13,400
$\frac{5}{16}$–$\frac{1}{2}$	Butt weld	12,000–19,000
0.302	Telescope weld of 11-in. and 10.6-in. welded tubes for circular strut, No. 10 electrode.	8,100

Strength Tests—A considerable number of tests of welded splices in plates and between plates and angles was made for guidance in this work. Some of the results obtained are tabulated and shown here.

The safe shear used on the basis of these tests, for welds parallel to the line of stress, ranges from 1,500 to 1,800 lb. for No. 10/5 welds and from 2,400 to 3,000 lb. for double run welds No. 10/5 and No. 8/5.5. For welds transverse to the line of stress, the allowable shear in the former case is 2,200 and in the latter 3,500.

Cantilever Erection of Long Spans of Missouri River Bridge

Flood and Drift Danger at Waverly Site Led to Adoption of Method of Cantilevering Over Temporary Bents

By L. J. Sverdrup
Assistant to Chief Engineer, Missouri Highway Department. Jefferson City, Mo.

THREE of the four steel bridges built by the Missouri State Highway Commission over the Missouri River were erected by means of ordinary falsework. For the fourth, that at Waverly, a special erection method was used, in order to reduce the risks of the work.

In erecting a bridge over a river like the Missouri the element of risk must be considered, especially when erection is to continue during the flood period (usually the latter part of June and the first part of July, and at times September). During even fairly light high-water stages the Missouri carries much drift, and falsework placed at every panel point is in danger of being carried away, unless the weight of the entire spans is on it; the weight of the floor system alone would not be sufficient to hold the falsework down against strong drift pressure. A very high flood would carry out the falsework even though the entire span was weighting it down.

To eliminate this danger no better or cheaper method than cantilever erection can be found with the use of a few supports only, the steel being cantilevered out from one such support to the next. Under this method the piles are concentrated in a few clusters, where they offer great resistance to even very high water and much drift and floating wreckage. Not only is the resistance concentrated, but very wide openings are provided. Further, the required amount of support can be put in place more economically in from two to four clusters than when scattered over the full length of the span. The saving effected is hardly large enough to offset the additional steel that has to be provided to take care of the cantilever stresses, but the element of risk decided in favor of the method at Waverly.

The Waverly bridge consists of two 416-ft. spans, three 250-ft. spans, one 145-ft. deck span and some short I-beam approach spans. The steel up to pier 1 was erected in the usual way with falsework under each panel. For the first 416-ft. span the plan was to use two clusters of 12 piles each for the first bent of falsework and two clusters of 15 piles each for the second bent. While this would have been sufficient from a bearing standpoint, the penetration was so small that it was thought better to use a few more piles, so a total of 30 piles was decided on for the first two clusters and 40 piles for the second two clusters (Bent 2). Difficulty was encountered in driving the piles for the upstream clusters due to a heavy current, nearness of rock to the stream bed, and boulders in the strata above the rock. Therefore 80 piles in all were used for the clusters of the first span, 70 in the four clusters for the next 416-ft. span, and four clusters of six each for the three 250-ft. spans.

After capping the piles, steel channels were used from the clusters up to the steel. These same channels were used throughout the work, with some modifications due

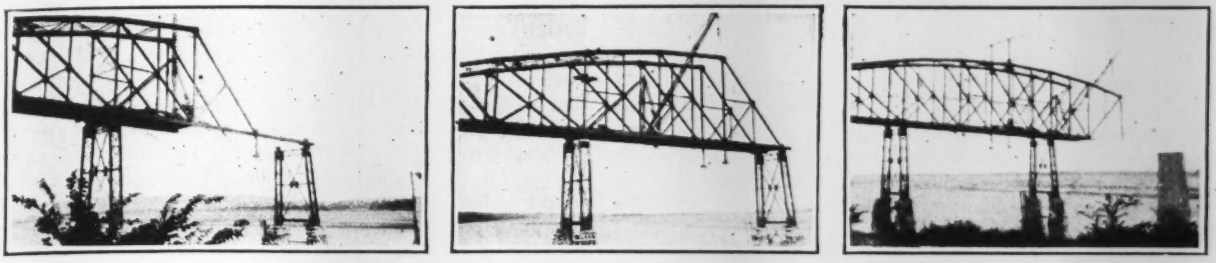


FIG. 1—PROGRESS OF ERECTION ON ONE OF THE LONG SPANS OF MISSOURI RIVER BRIDGE AT WAVERLY

to the grade of the bridge. In the case of the first span 2½ in. was allowed for settlement when capping the clusters; this proved to be about correct as a settlement of a little more than 2 in. was recorded. For the second

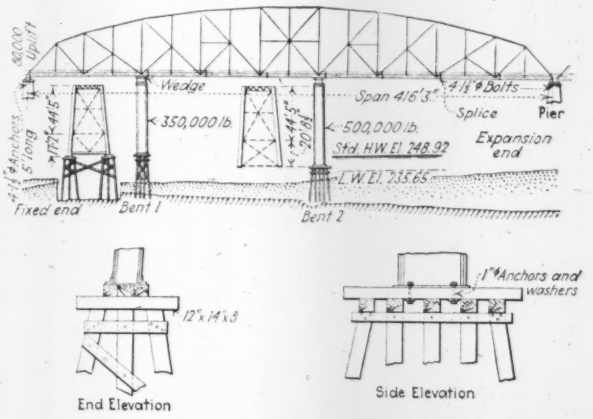


FIG. 2—ARRANGEMENT OF TEMPORARY BENTS

span a settlement of only slightly more than 1 in. was recorded. This was, however, to some extent due to the better cribbing on top of the piling.

The two 416-ft. spans had been designed for cantilever erection when the shop drawings were prepared, but not the 250-ft. spans. The additional stresses in the diagonals, however, were not greater than it was possible to take care of by clamping on top lateral sections to stiffen them. The bottom-chord sections were in some cases stiffened similarly. The accompanying sketches show various stages of the work and the corresponding stresses in the various members. The uplift of 80,000 lb. over the pier was taken care of by using anchor bolts 5 ft. long, grouted thoroughly into the pier, and by loading the end of the span with stringers and floorbeams. Hog rods were used, as shown, from the pier out to the first bent of falsework, a short strut running from the bottom of the second panel point to the hog rods

No particular difficulty was experienced during the erection, as all of the connections matched nicely and things in general went as anticipated. Field riveting of truss connections followed closely the erection of the members, so that all main members were practically fully riveted under a condition of no stress. Cross-frames and laterals were bolted temporarily, and riveted

FIG. 4—COMPLETED 416-FT. SPAN OF WAVERLY BRIDGE

after the erection of the span had been completed, to facilitate adjustment for elevation and so as not to delay the riveting of important members. To insure the erection of the floorbeams without difficulty, the stringer-connecting angles were bolted to the stringer webs until the span was swung, when the lengthening of the bottom

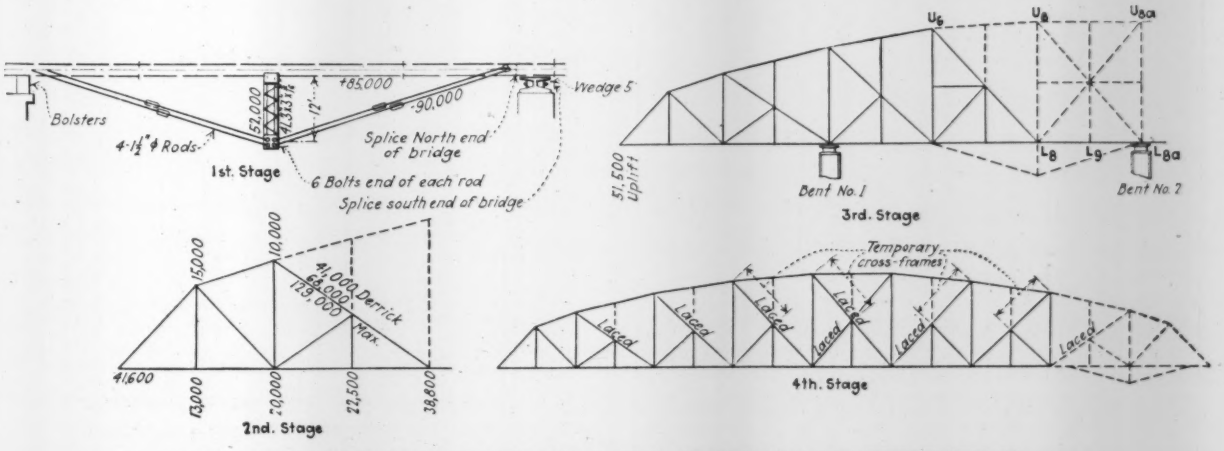


FIG. 3—FOUR STAGES IN THE ERECTION OF A LONG SPAN OF WAVERLY BRIDGE

chord from its previous compression to the final condition of tension permitted the riveting to be done fairly easily.

The total weight of the structural steel in the bridge as originally designed was 4,229,438 lb., while the actual weight was 4,263,090 lb., a difference of 33,552 lb. or 0.79 per cent due to cantilever erection. As the contract price for steel erected and painted was 6c. per lb., the additional cost would appear to be $2,013.12, but since the contractor's profit is included in this the actual additional cost was negligible, while the gain in safety due to the large openings provided was very large.

The work was done for the Missouri State Highway Commission, B. H. Piepmeier, chief engineer, by the Wisconsin Bridge and Iron Co., F. A. Ross, erection manager, and A. B. Marlborough, superintendent. The work came under the direct supervision of the writer, with H. F. Nelson as resident engineer.

Fort Lee Bridge Superstructure Bids

In Unusually Close Bidding, Prices on Wire-Cable Design Are Ten Per Cent Lower Than On Eyebar Design

BIDS for building the superstructure of the 3,500-ft. Fort Lee suspension bridge, received last week by the Port of New York Authority, proved to be remarkably close. A brief summary of the figures was given in our news pages last week, page 563. The complete figures are of interest because they answer a number of questions that were left open in the design of the bridge. The chief of these questions is the choice between wire and eyebar cables as the principal carrying members.

As described in *Engineering News-Record* of Aug. 11, page 212, the Fort Lee bridge project was worked out in two separate designs, one for parallel-wire cable construction and the other for eyebar chains as main cables. The latter form of construction was a strong competing factor because of (1) the development of high strength heat-treated eyebars in recent years to such a point that commercial guarantee of a minimum elastic limit of 75,000 lb. per sq.in. is offered, and (2) the great span of the structure, which makes a relatively high dead weight advantageous rather than objectionable since a heavier structure is inherently steadier under traveling loads and therefore requires less provision for stiffening. The two designs are of precisely the same outline, height of tower, sag of cable, and construction of floor and anchorages. The essential differences were in the cables themselves, and in the strength of the towers and anchorages, these being heavier in the eyebar cable design because of the greater dead weight of the span. The towers in both designs include both carbon steel (ordinary structural steel) and silicon steel, the latter being used for the main members. The towers of the eyebar cable design not only weigh about 500,000 lb. more than the others, but also comprise a slightly larger proportion of silicon steel (63½ per cent against 61 per cent).

The wire cables are to be made of wire having a minimum tensile strength of 220,000 lb. per sq.in. and an average of 225,000. They are proportioned for a maximum stress of 82,000 lb. per sq.in. There are four cables of 30 in. diameter, two on each side. The eyebar cables are to be made of bars having a minimum elastic limit of 75,000 lb. per sq.in., and are proportioned for a maximum stress of 50,000 lb. per sq.in. The cable on each side of the bridge consists of 96 bars 16 in. wide and of maximum thickness 2¼ in.

Wire-Cable Design Cheapest—The bids show the wire-cable design to be distinctly cheaper than the other. In the bids for the entire work, the lowest eyebar bid is about 7 per cent above the lowest wire bid. Still lower figures, however, are obtained from the combination of separate cable and steelwork bids, the lowest of which is 2 per cent under the lowest bid for the entire work.

When all bids are grouped in order of total price, as in Table 1, the seven first are for the wire-cable bridge, and the lowest eyebar bid is nearly 10 per cent higher than the lowest wire-cable bid.

Cable Cost—Three bids were received for wire cables (see Table 1), with total prices for the four 30-in. cables erected, wrapped and painted from $12,339,977 to $14,979,455. Two of the bids were only about $350,000 apart, and as the higher one included a charge of $280,000 for extra interest during construction the bids on bare construction cost were only $60,000 apart, one-half of one per cent. The principal item, the cable wire (57,200,000 lb.) was priced at 15.75, 15.3806 and 18.71c. per lb. For the eyebar cables only one bid was received, $13,985,605; the largest item, heat-treated eye-bars in the cables (148,200,000 lb.) was priced at 8.48c. per lb. However, in two bids for the complete superstructure

TABLE I—BIDS FOR CONSTRUCTING STEEL SUPERSTRUCTURE OF FORT LEE SUSPENSION BRIDGE

Entire Steel Work				Towers and Floor			Cables and Anchorage Steel				Total for Comparison
Bidder	Cable Type	Method of Erection	Amount	Bidder	Cable Type	Amount	Bidder	Cable Type	Method of Erection	Amount	
				McC.-M. Co.	Wire	$10,134,440.00	Roebling	Wire	Succ.	$12,339,977.00	$22,474,417
				A. B. Co.	Wire	10,305,220.00	Roebling	Wire	Succ.	12,339,977.00	22,645,197
				Mc.-M. Co.	Wire	10,134,440.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*22,817,608
				Bethlehem	Wire	10,621,020.00	Roebling	Wire	Succ.	12,339,977.00	22,960,997
McC.-M. Co.	Wire	Simult.	*23,026,620.00	A. B. Co.	Wire	10,305,220.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*22,988,388
											*23,026,620
A. B. Co.	Eyebar	Succ.	24,485,370.00	Bethlehem	Wire	10,621,020.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*23,304,188
											24,485,370
A. B. Co.	Wire	Succ.	24,670,800.00	McC.-M. Co.	Eyebar	10,640,040.00	A. B. Co.	Eyebar	Succ.	13,985,605.00	24,625,645
											24,670,800
				McC.-M. Co.	Wire	10,134,440.00	A. B. Co.	Wire	Succ.	14,979,455.00	25,113,895
				Bethlehem	Eyebar	11,143,670.00	A. B. Co.	Eyebar	Succ.	13,985,605.00	25,129,275
McC.-M. Co.	Eyebar	Succ.	25,962,020.00	Bethlehem	Wire	10,621,020.00	A. B. Co.	Wire	Succ.	14,979,455.00	25,600,475
											25,962,020
				A. B. Co.	Eyebar	10,821,620.00					

McC. Co. indicates McClintic Marshall Co.; A. B. Co., American Bridge Co.; Bethlehem, Bethlehem Steel Co.; Roebling, John A. Roebling & Sons Co.; Am. Cable Co., American Cable Co.

Simult. indicates simultaneous erection of superstructure and cables; Succ. indicates successive erection.

* Figures shown include $280,000 added to the estimated total price.

TABLE II—SUMMARY OF BIDS FOR ERECTION OF ENTIRE STEELWORK

Description	Wire Cable Design: Quantities for Comparison	McClintic Marshall Co. (Simultaneous Erection): Unit Price	McClintic Marshall Co. (Simultaneous Erection): Amount	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount	Description	Eyebar Cable Design: Quantities for Comparison	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount	McClintic Marshall Co. Successive Erection): Unit Price	McClintic Marshall Co. Successive Erection): Amount
le wire	57,200,000 lbs.	.164	9,380,800	.1781	10,187,320	Heat treated eyebars in cables	114,200,000 lbs.	.0823	9,398,660	.098	11,191,600
t treated bolts	170,000 lbs.	.15	25,500	.17	28,900	Heat treated pins except those in Item 4	5,640,000 lbs.	.1450	817,800	.165	930,600
bars and pins except those Item 4	lump sum	.....	685,000	.....	790,760	Heat treated eyebars in anchorage ex. Item 4	8,790,000 lbs.	.0855	751,545	.09	791,100
bars and pins delivered for mbedment	lump sum	.....	212,000	.....	217,500	Heat treated eyebars and pins delivered	1,760,000 lbs.	.0635	111,760	.08	140,800
pender ropes	170,000 ft.	2.70	459,000	3.00	510,000	Suspender ropes	166,000 ft.	2.00	332,000	2.70	448,200
d ropes	40,000 ft.	.60	24,000	.35	14,000	Hand ropes	30,000 ft.	.30	9,000	.60	18,000
bon steel in cables and anchorage ex. Item 8	7,330,900 lbs.	.072	527,760	.0925	678,025	Carbon steel in cables and anchorage ex. Item 8	8,650,000 lbs.	.084	726,600	.07	605,500
bon steel girders delivered r embedment	1,660,000 lbs.	.051	84,660	.0585	97,110	Carbon steel girders and grillages delivered	1,080,000 lbs.	.0585	63,180	.05	54,000
bon steel in towers	30,400,000 lbs.	.088	2,675,200	.093	2,827,200	Carbon steel in towers	32,200,000 lbs.	.0885	2,849,700	.084	2,704,800
bon steel in floor except hat in item 15	13,700,000 lbs.	.074	1,013,800	.0775	1,061,750	Carbon steel in floor except that in Item 15	13,800,000 lbs.	.077	1,062,600	.074	1,021,200
on steel in cables and anchorages	870,000 lbs.	.086	74,820	.1025	89,175	Silicon steel in cables and anchorages	1,400,000 lbs.	.0975	136,500	.085	119,000
on steel in towers	47,600,000 lbs.	.095	4,522,000	.0995	4,736,200	Silicon steel in towers	56,000,000 lbs.	.0955	5,348,000	.091	5,096,000
on steel in floor	11,800,000 lbs.	.081	955,800	.083	979,400	Silicon steel in floor	13,000,000 lbs.	.083	1,079,000	.081	1,053,000
kel steel in floor	4,700,000 lbs.	.106	498,200	.1025	481,750	Nickel steel in floor	2,500,000 lbs.	.10	250,000	.106	265,000
ms and tie rods in roadway lab	2,440,000 lbs.	.066	161,040	.064	156,160	Beams and tie rods in roadway slab	2,440,000 lbs.	.064	156,160	.066	161,040
steel and cast iron	5,250,000 lbs.	.163	855,750	.228	1,197,000	Cast steel and cast iron	5,000,000 lbs.	.145	725,000	.13	650,000
onze	40,000 lbs.	.70	28,000	.668	26,720	Bronze	40,000 lbs.	.668	26,720	.70	28,000
ment mixed in concrete	43,800 bbls.	3.00	131,400	3.75	164,250	Cement mixed in concrete	37,800 bbls.	3.75	141,750	3.00	113,400
ncrete	29,200 cu.yds.	7.50	219,000	10.00	292,000	Concrete	25,200 cu.yds.	10.00	252,000	7.50	189,000
inforcing steel in anchorage	200,000 lbs.	.062	12,400	.0655	13,100	Reinforcing steel in anchorage	190,000 lbs.	.0655	12,445	.062	11,780
bars tested to destruction	270,000 lbs.	.097	26,190	.0955	25,785	Heat treated eyebars tested to destruction	3,700,000 lbs.	.0635	234,950	.10	370,000
pping wire	830,000 lbs.	.21	174,300	.1165	96,695						
imated total contract price			22,746,620		24,670,800	Estimated total contract price			24,485,370		25,962,020
dition if simultaneous erection ($280,000)			280,000			Addition if simultaneous erection ($280,000)					
Total for comparison of bids			23,026,620		24,670,800	Total for comparison of bids			24,485,370		25,962,020

TABLE III—SUMMARY OF BIDS FOR CONSTRUCTION OF CABLES AND SUSPENDERS AND ERECTION OF ANCHORAGE STEELWORK

Description	Wire Cable Design (cables side by side): Quantities for Comparison	J. A. Roebling's Sons Co. (Successive Erection): Unit Price	J. A. Roebling's Sons Co. (Successive Erection): Amount	American Cable Co., Inc. (Simultaneous Erection): Unit Price	American Cable Co., Inc. (Simultaneous Erection): Amount	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount	Description	Eyebar Cable Design: Quantities for Comparison	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount
le wire	57,200,000 lbs.	.1575	9,009,000	.153806	8,797,703.20	.1871	10,702,120	Heat treated eyebars in cables	114,200,000 lbs.	.0848	9,684,160
t treated bolts	170,000 lbs.	.10	17,000	.22134	37,627.80	.17	28,900	Heat treated pins except those in item 4	5,640,000 lbs.	.1465	826,260
bars and pins except those in item 4	lump sum	.....	604,585	.....	675,744.90	.....	805,680	Heat treated eyebars in anchorages ex. item 4	8,790,000 lbs.	.086	755,940
bars and pins delivered for embedment	lump sum	.....	212,152	.....	215,067.00	.....	217,500	Heat treated eyebars and pins delivered	1,760,000 lbs.	.0635	111,760
pender ropes	170,000 ft.	2.25	382,500	2.54345	432,386.50	3.35	569,500	Suspender ropes	166,000 ft.	2.00	332,000
d ropes	40,000 ft.	.30	12,000	.609887	24,395.48	.35	14,000	Hand ropes	30,000 ft.	.30	9,000
bon steel except that item 8	7,330,000 lbs.	.079	579,070	.08262	605,604.60	.094	689,020	Carbon steel except that in item 8	8,650,000 lbs.	.085	735,250
bon steel girders delivered for embedment	1,660,000 lbs.	.049	81,340	.051	84,660.00	.0585	97,110	Carbon steel girders and grillages delivered	1,080,000 lbs.	.0585	63,180
on steel	870,000 lbs.	.089	77,430	.153	133,110.00	.1025	89,175	Silicon steel	1,400,000 lbs.	.0975	136,500
steel and cast iron	5,150,000 lbs.	.14	721,000	.145248	748,027.20	.228	1,174,200	Cast steel and cast iron	4,900,000 lbs.	.142	695,800
onze	20,000 lbs.	.40	8,000	.714	14,280.00	.668	13,360	Bronze	20,000 lbs.	.668	13,360
ment mixed in concrete	42,000 bbls.	3.15	132,300	3.1824	133,660.80	3.75	157,500*	Cement mixed in concrete	36,000 bbls.	3.75	135,000
ncrete	28,000 cu.yds	10.00	280,000	6.375	178,500.00	10.0	280,000	Concrete	24,000 cu.yds.	10.00	240,000
inforcing steel in anchorage	200,000 lbs.	.07	14,000	.0612	12,240.00	.0655	13,100	Reinforcing steel in anchorage	190,000 lbs.	.0655	12,445
bars tested to destruction	270,000 lbs.	.10	27,000	.09741	26,300.70	.0955	25,785	Heat treated eyebars tested to destruction	3,700,000 lbs.	.0635	234,950
pping wire	830,000 lbs.	.22	182,600	.342	283,860.00	.1235	102,505				
timated total contract price			12,339,977		12,403,168.18		14,979,455*	Estimated total contract price			13,985,605
dition if simultaneous erection ($280,000)					280,000.30			Addition if simultaneous erection ($280,000)			
tal for comparison of bids			12,339,977		12,683,168.18		14,979,455*	Total for comparison of bids			13,985,605

contract the cable eyebars were priced at 8.23 and 9.08c. respectively.

On towers and suspended structure, three bids under the wire cable design ranged from $10,134,440 to $10,621,020, a range of less than 5 per cent; three bids under the eyebar cable design ranged from $10,620,040 to $11,143,670, or about the same percentage.

Position of Cables.—In the wire cable design there are four 30-in. cables, two on each side of the bridge. The original project contemplated building first one cable on each side, then proceeding with the erection of the suspended structure and spinning the second cable later. The design therefore placed the two cables one above the other, as shown in our article of Aug. 11. However, alternative details were designed to permit of placing the two cables side by side if preferred by the builders, and bids were asked on both arrangements. All bids received on wire cable construction were for cables side by side.

chord from its previous compression to the final condition of tension permitted the riveting to be done fairly easily.

The total weight of the structural steel in the bridge as originally designed was 4,229,438 lb., while the actual weight was 4,263,090 lb., a difference of 33,552 lb. or 0.79 per cent due to cantilever erection. As the contract price for steel erected and painted was 6c. per lb., the additional cost would appear to be $2,013.12, but since the contractor's profit is included in this the actual additional cost was negligible, while the gain in safety due to the large openings provided was very large.

The work was done for the Missouri State Highway Commission, B. H. Piepmeier, chief engineer, [illegible] Wisconsin Bridge and Iron Co., F. A. Ross, e manager, and A. B. Marlborough, superintendent work came under the direct supervision of the with H. F. Nelson as resident engineer.

Fort Lee Bridge Superstructure l

In Unusually Close Bidding, Prices on Wire Design Are Ten Per Cent Lower Than On Eyebar Design

BIDS for building the superstructure of the 3. Fort Lee suspension bridge, received last w the Port of New York Authority, proved to be r ably close. A brief summary of the figures wa. in our news pages last week, page 563. The c figures are of interest because they answer a nun questions that were left open in the design of the The chief of these questions is the choice betwe and eyebar cables as the principal carrying memb

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The wire cables are to be made of wire having a mini-

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$13,985,605; the largest item, heat-treated eye-bars in the cables (148,200,000 lb.) was priced at 8.48c. per lb. However, in two bids for the complete superstructure

TABLE I—BIDS FOR CONSTRUCTING STEEL SUPERSTRUCTURE OF FORT LEE SUSPENSION BRIDGE

Entire Steel Work				Towers and Floor			Cables and Anchorage Steel				Total for Comparison
Bidder	Cable Type	Method of Erection	Amount	Bidder	Cable Type	Amount	Bidder	Cable Type	Method of Erection	Amount	
				McC.-M. Co.	Wire	$10,134,440.00	Roebling	Wire	Succ.	$12,339,977.00	$22,474,417
				A. B. Co.	Wire	10,305,220.00	Roebling	Wire	Succ.	12,339,977.00	22,645,197
				Mc.-M. Co.	Wire	10,134,440.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*22,817,608
				Bethlehem	Wire	10,621,020.00	Roebling	Wire	Succ.	12,339,977.00	22,960,997
McC.-M. Co.	Wire	Simult.	*23,026,620.00	A. B. Co.	Wire	10,305,220.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*22,988,388
				Bethlehem	Wire	10,621,020.00	Am. Cable Co.	Wire	Simult.	*12,683,168.18	*23,026,620
A. B. Co.	Eyebar	Succ.	24,485,370.00								*23,304,188
				McC.-M. Co.	Eyebar	10,640,040.00	A. B. Co.	Eyebar	Succ.	13,985,605.00	24,485,370
A. B. Co.	Wire	Succ.	24,670,800.00								24,625,645
				McC.-M. Co.	Wire	10,134,440.00	A. B. Co.	Wire	Succ.	14,979,455.00	24,670,800
				Bethlehem	Eyebar	11,143,670.00	A. B. Co.	Eyebar	Succ.	13,985,605.00	25,113,895
				Bethlehem	Wire	10,621,020.00	A. B. Co.	Wire	Succ.	14,979,455.00	25,129,275
McC.-M. Co.	Eyebar	Succ.	25,962,020.00								25,600,475
				A. B. Co.	Eyebar	10,821,620.00					25,962,020

McC. Co. indicates McClintic Marshall Co.; A. B. Co., American Bridge Co.; Bethlehem, Bethlehem Steel Co.; Roebling, John A. Roebling & Sons Co.; Am. Cable Co., American Cable Co.

Simult. indicates simultaneous erection of superstructure and cables; S indicates successive erection.

* Figures shown include $280,000 added to the estimated total price.

TABLE II—SUMMARY OF BIDS FOR ERECTION OF ENTIRE STEELWORK

Description	Wire Cable Design: Quantities for Comparison	McClintic Marshall Co. (Simultaneous Erection): Unit Price	McClintic Marshall Co. (Simultaneous Erection): Amount	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount
e wire	57,200,000 lbs.	.164	9,380,800	.1781	10,187,320
t treated bolts	170,000 lbs.	.15	25,500	.17	28,900
ars and pins except those Item 4	lump sum	.....	685,000	.....	790,760
ars and pins delivered for	lump sum	.....	212,000	.....	217,500
bedment	170,000 ft.	2.70	459,000	3.00	510,000
ender ropes	40,000 ft.	.60	24,000	.35	14,000
d ropes					

Description	Eyebar Cable Design: Quantities for Comparison	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount	McClintic Marshall Co. (Successive Erection): Unit Price	McClintic Marshall Co. (Successive Erection): Amount
Heat treated eyebars in cables	114,200,000 lbs.	.0823	9,398,660	.098	11,191,600
Heat treated pins except those in Item 4	5,640,000 lbs.	.1450	817,800	.165	930,600
Heat treated eyebars in anchorage ex. Item 4	8,790,000 lbs.	.0855	751,545	.09	791,100
Heat treated eyebars and pins delivered	1,760,000 lbs.	.0635	111,760	.08	140,800
Suspender ropes	166,000 ft.	2.00	332,000	2.70	448,200
	30,000 ft.	.30	9,000	.60	18,000
and an-	8,650,000 lbs.	.084	726,600	.07	605,500
nd grill-	1,080,000 lbs.	.0585	63,180	.05	54,000
	32,200,000 lbs.	.0885	2,849,700	.084	2,704,800
except	13,800,000 lbs.	.077	1,062,600	.074	1,021,200
les and	1,400,000 lbs.	.0975	136,500	.085	119,000
	56,000,000 lbs.	.0955	5,348,000	.091	5,096,000
	13,000,000 lbs.	.083	1,079,000	.081	1,053,000
	2,500,000 lbs.	.10	250,000	.106	265,000
in road-	2,440,000 lbs.	.064	156,160	.066	161,040
n	5,000,000 lbs.	.145	725,000	.13	650,000
	40,000 lbs.	.668	26,720	.70	28,000
rete	37,800 bbls.	3.75	141,750	3.00	113,400
	25,200 cu.yds.	10.00	252,000	7.50	189,000
chorage	190,000 lbs.	.0655	12,445	.062	11,780
ested to	3,700,000 lbs.	.0635	234,950	.10	370,000
act price			24,485,370		25,962,020
us erec-					
n of bids			24,485,370		25,962,020

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AND ERECTION OF ANCHORAGE STEELWORK

Description	Eyebar Cable Design: Quantities for Comparison	American Bridge Co. (Successive Erection): Unit Price	American Bridge Co. (Successive Erection): Amount
Heat treated eyebars in cables	114,200,000 lbs.	.0848	9,684,160
Heat treated pins except those in item 4	5,640,000 lbs.	.1465	826,260
Heat treated eyebars in anchorages ex. item 4	8,790,000 lbs.	.086	755,940
Heat treated eyebars and pins delivered	1,760,000 lbs.	.0635	111,760
Suspender ropes	166,000 ft.	2.00	332,000
Hand ropes	30,000 ft.	.30	9,000
Carbon steel except that in item 8	8,650,000 lbs.	.085	735,250
Carbon steel girders and grillages delivered	1,080,000 lbs.	.0585	63,180
Silicon steel	1,400,000 lbs.	.0975	136,500
Cast steel and cast iron	4,900,000 lbs.	.142	695,800
Bronze	20,000 lbs.	.668	13,360
Cement mixed in concrete	36,000 bbls.	3.75	135,000
Concrete	24,000 cu.yds.	10.00	240,000
Reinforcing steel in anchorage	190,000 lbs.	.0655	12,445
Heat treated eyebars tested to destruction	3,700,000 lbs.	.0635	234,950
Estimated total contract price			13,985,605
Addition if simultaneous erection ($280,000)			
Total for comparison of bids			13,985,605

tem 8	7,330,000 lbs.	.079	579,070	.08262	605,604.60	.094	689,020
n steel girders de-							
red for embedment	1,660,000 lbs.	.049	81,340	.051	84,660.00	.0585	97,110
n steel	870,000 lbs.	.089	77,430	.153	133,110.00	.1025	89,175
steel and cast iron	5,150,000 lbs.	.14	721,000	.145248	748,027.20	.228	1,174,200
ze	20,000 lbs.	.40	8,000	.714	14,280.00	.668	13,360
nt mixed in concrete	42,000 bbls.	3.15	132,300	3.1824	133,660.80	3.75	157,500*
crete	28,000 cu.yds	10.00	280,000	6.375	178,500.00	10.0	280,000
forcing steel in an-							
orage	200,000 lbs.	.07	14,000	.0612	12,240.00	.0655	13,100
ars tested to de-							
truction	270,000 lbs.	.10	27,000	.09741	26,300.70	.0955	25,785
pping wire	830,000 lbs.	.22	182,600	.342	283,860.00	.1235	102,505
timated total con-							
tract price			12,339,977		12,403,168.18		14,979,455*
dition if simultane-							
erection ($280,000)					280,000.00		
al for comparison of							
ids			12,339,977		12,683,168.18		14,979,455*

contract the cable eyebars were priced at 8.23 and 9.08c. respectively.

On towers and suspended structure, three bids under the wire cable design ranged from $10,134,440 to $10,621,020, a range of less than 5 per cent; three bids under the eyebar cable design ranged from $10,620,040 to $11,143,670, or about the same percentage.

Position of Cables.—In the wire cable design there are four 30-in. cables, two on each side of the bridge. The original project contemplated building first one cable on each side, then proceeding with the erection of the suspended structure and spinning the second cable later. The design therefore placed the two cables one above the other, as shown in our article of Aug. 11. However, alternative details were designed to permit of placing the two cables side by side if preferred by the builders, and bids were asked on both arrangements. All bids received on wire cable construction were for cables side by side.

TABLE IV—SUMMARY OF BIDS ON TOWER ERECTION AND FLOOR CONSTRUCTION

Description	Wire Cable Design							Eyebar Cable Design						
	Quantities for Comparison	McClintic Marshall Co.		American Bridge Co.		Bethlehem Steel Co.		Quantities for Comparison	McClintic Marshall Co.		American Bridge Co.		Bethlehem Steel Co.	
		Unit Price	Amount	Unit Price	Amount	Unit Price	Amount		Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
Carbon steel in towers	30,400,000 lbs.	.091	2,766,400	.093	2,827,200	.092	2,796,800	32,200,000 lbs.	.087	2,801,400	.0885	2,849,700	.087	2,8
Carbon steel in floor except that in item 6	13,700,000 lbs.	.074	1,013,800	.0775	1,061,750	.0795	1,089,150	13,800,000 lbs.	.074	1,021,200	.0775	1,069,500	.0795	1,0
Silicon steel in towers	47,600,000 lbs.	.098	4,664,800	.0995	4,736,200	.103	4,902,800	56,000,000 lbs.	.094	5,264,000	.0955	5,348,000	.099	5,5
Silicon steel in floor	11,800,000 lbs.	.081	955,800	.083	979,400	.0915	1,079,700	13,000,000 lbs.	.081	1,053,000	.0835	1,085,500	.0915	1,1
Nickel steel in floor	4,700,000 lbs.	.106	498,200	.1025	481,750	.1095	514,650	2,500,000 lbs.	.106	265,000	.10	250,000	.1095	2
Beams and tie rods in roadway slab	2,440,000 lbs.	.066	161,040	.064	156,160	.0715	174,460	2,440,000 lbs.	.066	161,040	.064	156,160	.0715	1
Cast steel and iron	100,000 lbs.	.28	28,000	.2585	25,850	.211	21,100	100,000 lbs.	.28	28,000	.2585	25,850	.211	
Bronze	20,000 lbs.	.70	14,000	.686	13,360	.87	17,400	20,000 lbs.	.70	14,000	.668	13,360	.87	
Cement mixed in conc.	1,800 bbls.	4.00	7,200	3.75	6,750	3.00	5,400	1,800 bbls.	4.00	7,200	3.75	6,750	3.00	
Concrete	1,200 cu.yds.	21.00	25,200	14.00	16,800	16.30	19,560	1,200 cu.yds.	21.00	25,200	14.00	16,800	16.30	
Estimated total contract price			10,134,440		10,305,220		10,621,020			10,640,040		10,821,620		11,4

Simultaneous or Successive Construction of Cables—As it is possible to begin erection of the suspended structure as soon as the first pair of cables is completed, the construction program was arranged to permit the contractor to build the second set of cables later than the first, or at his option to build both sets at the same time. Bids could be submitted under either plan. This is indicated in the accompanying tables by the words "Successive" or "Simultaneous." It was specified, however, that the time required for the construction of four cables under the simultaneous plan of erection could not be greater than the time for building the first pair of cables in the successive method of erection (completion by December 1, 1930). Further, the simultaneous plan of erection was charged with the sum of $280,000 as a lump-sum addition to the estimated construction price bid, to represent the extra cost to the Port Authority in interest during construction because of having to make larger construction payments at the earlier period. The bids show that the John A. Roebling Sons Co. and the American Bridge Co. elected the successive method of construction, while the American Cable Co. elected the simultaneous method.

The remarkable closeness of the bids throughout is believed to indicate keen competition and low prices. It is doubtless also in large part attributable to the unusual preparation of plans. This is further indicated by the fact that none of the bids submitted included any reservation or suggested any modification in plans or specifications.

Road Officials Stress Administrative Practices

Over 275 Delegates from State Highway Departments Urge Traffic Control, Increased Accident Prevention and the Intermediate Road Types at Denver Convention

BROAD problems of highway safety, public roads administration and traffic control supplemented by discussions of the development of intermediate road types and of research progress, completed, with the reports of the organization's working body of ten standing committees, the four days' sessions last week at Denver, Colo., of the American Association of State Highway Officials. All but five states of the 48 were represented by delegates. The program was arranged so as to give a variety of subjects to be considered at each session but for sake of succinctness in this summary of the proceedings the papers and reports have been grouped according to the nature of their general subject matter, regardless of their order in the program. The new officers elected under the revised constitution adopted at this convention are: president, Frank T. Sheets of Illinois; vice-presidents, John N. Mackall of Maryland, C. H. Moorefield of South Carolina, John W. Gardner of Kansas and Henry H. Blood of Utah; and treasurer, W. W. Mack, of Delaware. Including the endowment fund the association treasury has a balance in hand as of Sept. 15, 1927, of $9,752.

Administrative Questions—Opening with the report of the committee on administration the announcement was made of a standard system of accounting which divided highway accounts into fiscal accounts and cost records and recommended that the heads of cost accounting bureaus should be engineers. The new system provides that accounts shall be closed every calendar month so that the system can be adapted to either a fiscal year ending June 30 or to one coincident with the calendar year. The new system also recommends adoption of a budget plan for allotting and controlling expenditures. The committee further reported in favor of standardizing signs and signals in towns and villages. On the matter of pavement markings at railroad crossings it recommended two 2-ft. across-pavement bars 100 ft. from the crossing and two similar bars 500 ft. from the crossing, with the addition of the letters "R.R." between bars. A 10-ft. spacing of bars was specified. No standard form for recording road accidents had been agreed upon by the committee but it urged their collection and for the present suggested the form adopted by the National Safety Council. Positive condemnation was made of the use on two-way rural roads of center-of-the-road signals of any character at crossings. In the discussion it was announced that Wisconsin prohibits center signals in towns and villages as well as on rural roads. Also in Missouri the highway department prohibits center supports in overhead crossings of highways.

Touching on administration the report of the executive secretary brought out that in the year 21 states had made

changes in the officiary of their highway departments involving a change in the chairmanship of the commission or of its chief engineer, or both. Ten states changed both heads of commissions and chief engineers. Regarding sources of highway revenue and extent of highway expenditures the secretary's report pointed out that state roads received 59.2 per cent of the net receipts from gasoline taxes and motor license fees. Federal contributions averaged 13.2 per cent. The remaining 27.6 per cent of expenditures came from (1) in some states a general tax levy (2) in others, a bond issue, (3) in others a special tax on benefited road districts and (4) in others from oil royalties, etc. Federal payments to states ranged from 2.6 per cent to 58 per cent of their total expenditures.

On the basis of $1,200,000,000 total expenditure, federal payments amounted to 6.1 per cent. The average gas tax was 2.7c. a gallon and the average license fee per car was $13.14. The highest road expenditure per capita was $20.24 in Nevada and the lowest was $2.65 in Georgia. For the whole country it was $6.47. Per $100 actual wealth the highest expenditure was 75c. in North Carolina and the lowest was 5c. in Delaware. The average for the United States was 23c. New Jersey spent $11,080 per mile, North Dakota $260 per mile and the United States $2,508 per mile, including in all cases only state system roads. Federal expenditures toward these same roads were 66c. per capita, 2 mills per $100 of wealth and $269 per mile. Two states, Maryland and Massachusetts, spent more for road maintenance than for new construction.

Court Decisions—Reviewing court decisions affecting highways, Hugh Stephens, commissioner, Missouri, states that the courts have in the main upheld the authority of the highway commissioners and given the laws liberal and helpful interpretations. The federal courts have sustained the rights of states to put upon interstate traffic its share of the burden of building and preserving the highways. Where legislatures have not designated routes the courts have granted commissions great freedom both in designation of routes and traffic control. Commenting along similar lines on state and federal control, Pyke Johnson, National Automobile Chamber of Commerce, expressed the opinion that intrastate regulation should be left entirely to the states while interstate regulation should be a subject for co-operative action by the states under some such plan as that now in effect between the Interstate Commerce Commission and the state commissions.

In a paper on personnel selection and training T. Warren Allen, U. S. Bureau of Public Roads, described a plan of the bureau in selecting junior college students of high standing and giving them vacation employment with the idea of developing an interest which would result in these men, after graduation, joining the bureau staff. By taking on junior students the bureau got a chance to get picked men and also to determine their aptitude for road work before permanent employment. The measure of success so far has been encouraging.

Commenting on the purposes of federal aid, Thomas H. MacDonald, chief, Bureau of Public Roads, spoke of the lack of co-operation by states in the federal object of building continuous routes and announced that "the United States Bureau of Public Roads is now prepared, failing to obtain co-operation for the completion of important thoroughfares, to insist upon a recognition of the requirements of the law which provides for expediting the completion of these routes."

Writing of bonding practices W. R. Neel, Georgia, reviewed the various efforts to secure practical co-operation between contractors, surety companies and engineers. He said that present bonding practices neither indicated that a bonded contractor was responsible, nor fully protected the state from irresponsibility and that surety rates were too high. The duty then was directly on the state to determine responsibility and in this task the standard questionnaires approved by the association should be used. In discussion H. J. Kuelling, Wisconsin, commended the Wisconsin practice of yearly classifying and rating contractors and requiring all bidders to be "approved" by the review board of the department. As to surety he suggested that it might be well for the states to do their own bonding. G. F. Schlesinger, Ohio, announced great success in Ohio in using the standard questionnaires and urged that they be used as drafted and not in any modified form.

In a paper on state highway department responsibility in the protection of life and property G. C. Dillman, Michigan, directed attention chiefly to the possible physical means. Among these were wide rights-of-way, wide pavements, wide shoulders, foot paths, guard fences, flat curves superelevated, good sight distances, wide bridges, dust palliatives, careful detour selection, grade crossing elimination and careful marking. He urged a 100-ft. right-of-way to provide for an ultimate 40-ft. pavement and 8-ft. shoulders.

In discussion Harry J. Kirk, Ohio, pointed out that statistics indicated that relatively few accidents were caused by roadway defects and that preventive efforts could more effectively be directed to other causes. J. N. Mackall, Maryland, deplored the practice of 100 per cent traffic line markings as begetting contempt of pavement marking as warnings. He was supported by H. G. Shirley, Virginia, who advocated the reduction of all warnings to a minimum and then drastic punishment for violations. F. T. Sheets, Illinois, considered continuous marking to be very desirable.

Technical Subjects—Aside from committee reports only two papers had subjects of strictly technical character. V. L. Glover, Illinois, described recent studies in Illinois on concrete control and six-wheel truck loadings. In the matter of concrete control studies had been made in the field on half a hundred jobs of the bulking of sand due to moisture and of the settlement of coarse aggregate in hauling. As a result in volumetric proportioning a working rule had been adopted of adding 15 per cent to sand, 6 per cent to gravel and 8 per cent to stone in making the standard proportions of $1:2:3\frac{1}{2}$. In the truck tests it was found that with axles spaced over 2 ft. apart the stresses were not greater with two 16,000-lb. axle loads than with a single 16,000-lb. axle load. To provide for heavy trucks the state load limit law has been amended to allow 40,000 lb. maximum loads on six-wheel trucks with a minimum axle spacing of 40 in. It was believed that the six-wheel truck was a solution of the problem of increasing load limits without danger to pavements designed for four-ton wheel loads.

In discussion E. F. Kelley, Bureau of Public Roads, pointed out that the Illinois truck tests confirmed those made a year or two ago by the bureau. Among current highway research undertakings he directed attention to the long test roads in California and Virginia, to the

study of subsoils now going on and to the notable North Carolina concrete bridge tests.

The second technical paper on bituminous treatment of gravel and crushed stone roads was read by T. E. Stanton, California, and summarized experience with the surface treatment and surface mixing processes employed so successfully in Oregon and California. In surface mixing the surface of previously constructed fine crushed rock—1½ to ¾ in.—or gravel is scarified to a uniform depth of 1½ to 3 in. according to the thickness of bituminous surface desired. Oil—60 to 70 asphalt and 80 penetration—is applied in two or three applications of about ½ gal. per square yard. After each application the oil is partially mixed with the material by means of a disk cultivator or a spring tooth harrow or both. The material is then bladed repeatedly into windrows and respread until uniform color is obtained. After the mixing the material is spread to final crown and continuously dragged or bladed while compacting under traffic.

In surface treatment the road surface is swept clean of all loose material. Oil is then applied under pressure at the rate of about $\frac{3}{10}$ gal. a square yard and allowed to penetrate two or three days. Then a second oil application of $\frac{2}{10}$ gal. is made and allowed to penetrate for several days. Finally stone chips are spread at the rate of 40 to 100 cu.yd. per mile (18-ft. roadway).

Both types of surface, it is stated, furnish impressive figures of good service and low costs. Incidentally an investigation by the Bureau of Public Roads and the California Department of Public Works of these light asphaltic oil road surfaces for intermediate road types is about now available in a 100-page pamphlet published by the California department.

Committee Reports—Owing to reorganization during the year of the associations line-up of technical committees only partial reports were made by any. By the new organization one committee on standards will include half a dozen or so sub-committees on design, construction, maintenance, bridges, etc. These committees will report separately (1) specifications and (2) standard practices. At this meeting the committee on construction recommended proportioning of concrete by weight and the giving of more consideration to the use of high early-strength concrete mixtures. In the matter of standard markings the committee reported 100 per cent compliance by 25 states, with all but two other states making progress and two states as having taken no action. In concrete pavement design the committee approved 10-ft. traffic lanes and 8-ft. shoulders; no thickness less than 6 in.; a longitudinal center joint with dowels; a 1-in. crown and concrete control which would guarantee a strength of 3,500 lb. in 28 days.

Resolutions—Resolutions were passed (1) recommending the prohibition of all advertising signs on the right-of-way and so far as could be managed on private property adjacent to the right-of-way; (2) expressing the policy that at least half the cost of grade crossing elimination should be borne by the railway; (3) reaffirming the previous resolution of the association in respect to toll bridges; (4) amending the federal aid law to make possible in certain cases greater participation in cost of construction than the present limitations allow; (5) asking continuation of federal aid at the present rates; and (6) asking Congress to extend invitations for holding the next international highway congress in the United States.

Building Costs and Industrial Progress

Industry And Foreign Trade Are Burdened By High Cost of Building—Survey of Cost Factors Proposed

(From an address delivered before the New York Building Congress on Oct. 5 under the title "The Building Industry, a Help or Handicap to Uncle Sam.")

By E. J. Mehren
Vice-President, McGraw-Hill Publishing Co., Inc.

THE building industry is not in foreign trade; but it is interested in foreign trade, for it places a burden on every shoestring, and typewriter, every machine tool, and electric motor that is shipped across the sea, and on every shoe, or yard of woolen goods or pocket knife made in this country, and that must meet the competition of foreign articles. If that building burden is unduly high, we handicap Uncle Sam. If low, we help him.

The building burden on manufactured goods is both direct and indirect. Direct in the charge for factory and office buildings, indirect in the rent element in every salary check and in every wage envelope, if home rents are abnormally high, salaries and wages must be raised proportionately, and the cost of goods goes up. If the house rents are low, selling prices can be proportionally reasonable.

What are the facts? Has the building industry unduly burdened other industry? Index figures show that the cost of building has risen more in this country since 1913 than have the selling prices of most of the items that enter into our everyday life. As against prices in 1913, food prices for the country are up 59 per cent; clothing 65; fuel and light 81; house furnishings 105; building cost 110. In other words, building costs have more than doubled. In New York, building costs are 114 per cent above 1913, so that building costs have risen more in New York than in the United States.

The motive of self interest should prompt us to inquire whether the public will not punish us if we callously allow our costs to remain out of line. We feel a certain sense of security, because ours is a protected security. If a man wants a building in New York, only New York can give it to him.

But that protection afforded our industry by the nature of our business is not a guaranty of immunity from public displeasure and discipline. The community is always more powerful than any of its parts. It can administer a severe punishment. It starved the railroads which incurred its displeasure. It forced electric railways by the dozens into receivership. It promises to go to the bottom of public-utility financing and no one can forsee the results.

What then can be done? We need, I believe, a thorough understanding of why building costs are high. Much cost data are available and known to architects, contractors and material men whose business is to know and study costs. But the figures must be spread before the industry as a whole and must be so complete that conclusions can safely be drawn.

When one talks of high building costs, there is always the suspicion that he is thinking of labor costs only, for those have been most frequently discussed. Undoubtedly, labor costs need to be studied, but so also do the city building code, the state factory laws, the prices of building materials, and the relations between architects and contractors and between the contractors and material dealers.

The cost of such a survey has not been estimated, but I would respectfully suggest to the Executive Committee of the Congress the consideration of ways and means of making it. New York State now has a State Industrial Survey Commission at work. Possibly funds could be secured to extend its work, and make, under its direction, a thorough inquiry by competent engineers and accountants. There is good precedent for such an activity. Does not the Federal Government study the efficiency of agriculture, and promote the development of foreign and domestic commerce?

A Series of Eight Articles on

Winter Construction Methods and Plant

BY C. S. HILL
Associate Editor, Engineering News-Record

1. Planning and Servicing Winter Construction
2. Winter Care and Servicing of Equipment
3. Winter Excavation and Embankment Construction
4. Concrete Road Construction in Winter
5 Winter Heating Concrete Materials and Mix
6. Handling and Placing Concrete in Winter
7. *Protecting Winter Placed Concrete*
8. Winter Inclosure in Building Construction

7. Protecting Winter Placed Concrete in Heavy Sections

INSULATION, inclosure or heating are required to hold placed concrete at active hardening temperatures somewhere above 50 deg. All the insulation needed in heavy sections may be provided by the regular forms or these may have to be thickly blanketed. So, also, the necessary inclosure may range from a mere cover of canvas to a complete and tight housing; the heating system may vary from a firepot to steam coils of elaborate arrangement. In discussing these housing and heating methods, a classification into heavy structures and into building construction is adopted. This is for the reason that for heavy structures special and individual designs and arrangements are required for each structure, while in building, the methods approximate standards of general application.

Heavy Concrete Structures—Simple structures and arrangements suffice in general for housing mass concrete in bridge piers, bridge arches, dams, walls and foundations. Dependence rather is put on heated concrete and the heat generated in setting to prevent frosting. Their mass in proportion to their surface exposed prevents frost action except at the very surface. Protection, then, is largely directed to keeping the surface unfrozen. Often the insulation of the forms is enough for this, and where more is required the necessity seldom exceeds canvas curtains and covers warmed underneath by firepots or steam jets. Where thin sections are included with the mass work, they must naturally be better guarded as described in article 8 for building construction.

Form Insulation—The insulating value of heavy wood forms is considerable. Steel forms give very little protection from frost. On the Dead River dam, Wisconsin, in sub-zero weather, it was observed that with steel forms frost would penetrate 2 or 3 in., when with 2-in. plank there was no freezing. If a curtain is hung over the outside of the wood form, its insulating value is increased by the dead air space which retards radiation. Care must be taken, however, to see that the covering does not have openings which make of it a flue for cold air currents up the outside of the forms.

More effective form insulation is secured by packing the back of wood forms with marsh hay, straw or, better, a strawy manure. On warehouse construction (Parklap, Inc., New York) in Montreal, 1926-27, wood panels for wall forms were packed between walls with manure held in place by roofers nailed onto the wales. A five-span concrete arch bridge, two 70-ft., two 72-ft. and one 74-ft., built in 1922 at Waterloo, Iowa, was protected by insulated forms for spandrel walls and by blanketing for the over-arch concrete. The spandrel wall forms were boards on 2 x 6-in. studs; between studs was packed a dry strawy manure retained by just enough across-stud battens to hold it. A similar manure insulation blanketed the top of the arch ring. The concrete temperatures on this work are given in Table III (article 6). Where staining or blemishing of the concrete surface has to be avoided, care must be taken in insulating by direct application of straw or manure, also care where they may be displaced by mud.

Protecting Bridge Piers—The massive compact structure of bridge piers and abutments makes enclosure and heating comparatively simple. Generally, canvas curtains over the outside forms and canvas covers over the top, Fig. 28, both heated underneath, are sufficient. A typical example is the pier protection employed on the Castleton Bridge near Albany, N. Y. The pier was concreted between Jan. 15 and March 15, and the weather was very cold, the thermometer on several occasions going to —10 deg. The sand and broken stone were stored in piles and kept warm by steam pipes laid in the bottom. The mixing water was heated to near the boiling point and the concrete as it left the mixer was at about 125 deg. To keep the concrete warm in the forms, outside steam pipes were installed and tarpaulins were hung outside the pipes. This protection was maintained for ten days. Each night tarpaulins were placed over the open tops of the forms and live steam allowed to escape into the space enclosed. (New York Central R.R., W. F. Jordan, engineer.)

In building the Delaware River suspension bridge at Philadelphia, the precautions with concrete on the anchorage foundations during the winter of 1922 to 1923 consisted of heating the aggregate and water before mixing and of heating the caissons while the concrete was

setting. The latter protection was afforded by the use of tarpaulins placed over the top of the green concrete and extended down the sides of the caissons to the bottom of the forms, with heating units placed inside the covers, Fig. 29. In Camden, salamanders were used to provide heat for both rectangular and circular caissons. In Philadelphia, salamanders were used for the circular caissons, but steam pipes were employed for the rectangular caissons. A pipe in which holes had been punched was

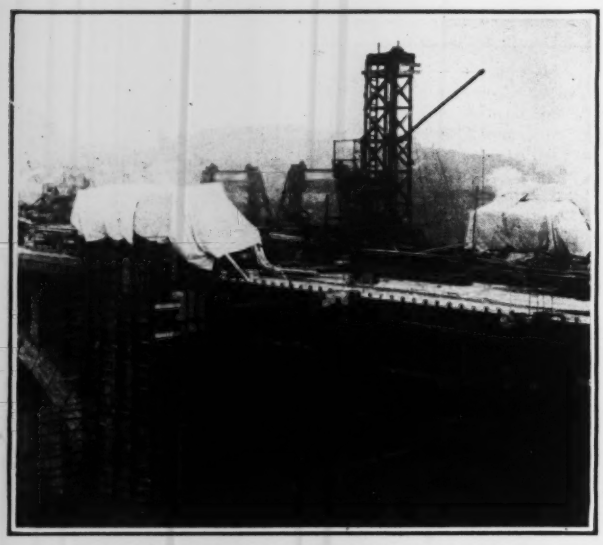


FIG. 28—TYPICAL CANVAS PIER TOP COVER

placed around the caisson at the bottom of the forms of the lift to be heated, each lift being 10 ft. high. The tarpaulins were extended down over this pipe. Steam passing out of the holes produced a warm, moist atmosphere, well suited for the setting. Temperature observations were made in oil-filled pipes set in the concrete of the outside walls of the caissons at distances of 6 in., 18 in., and 3 ft. from the outside face. They showed temperatures above 40 deg. with the outside air from 15 to 30 deg. The steam was supplied from the boilers in the contractor's plant, through asbestos-covered pipe laid on the construction bridge over Delaware Avenue. (Charles Carswell, engineering staff.)

A scheme of heating by steam similar to that employed on the Delaware River bridge anchorages was used in the

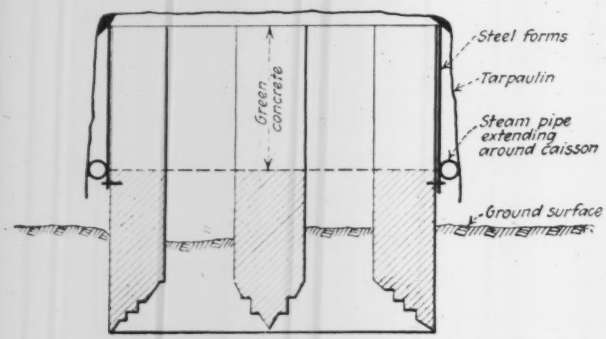


FIG. 29—ANCHORAGE PROTECTION, DELAWARE RIVER BRIDGE

construction of the Clark's Ferry bridge at Harrisburg, Pa., of which Frank M. Masters was engineer. The water and aggregate were heated before mixing, and then a steam pipe beneath tarpaulin covering was used to protect the green concrete. Steam was used for three days after the concrete had been poured. Temperatures in the concrete ranged from 60 to 82 deg. when the air was from 20 to 32 deg. An admixture of Cal was used on that bridge and the temperature observations indicated that the effect of Cal was more pronounced when the mix was heated. The observations also showed that the temperature of the concrete rose during setting only when the mixing temperature was above 55 deg. The Clark's Ferry bridge was built in 1924.

As an example of elaborate protection, the diagram Fig. 30 of bridge pier housing developed from experience in the winter construction of many such structures on the Grand Trunk Pacific Ry. in Canada in 1909-14 is presented. In general, the work below ground level or ice level can be heated by stoves; those on the work mentioned were provided both outside and inside the forms; those inside being supported on brackets and raised as the surface of the concrete was brought up. For the por-

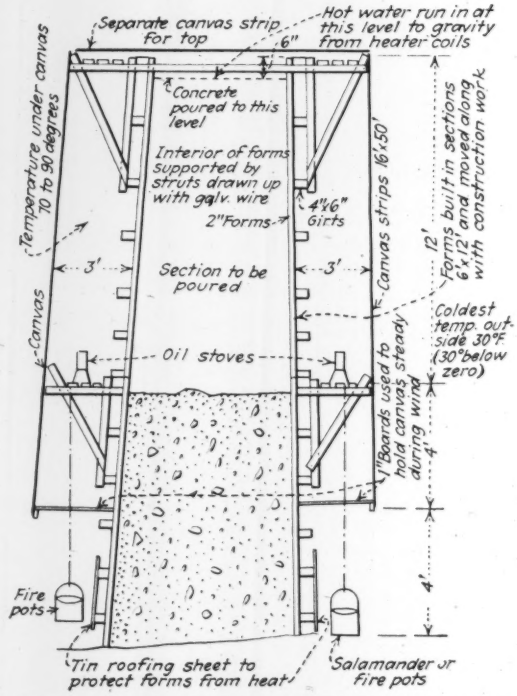

Separate canvas strip for top
6"
Hot water run in at this level to gravity from heater coils
Concrete poured to this level
Interior of forms supported by struts drawn up with galv. wire
2"Forms
4"x6" Girts
Temperature under canvas 10 to 50 degrees
Canvas strips 16'-50'
Forms built in sections 9'x12' and moved along with construction work
12'
3'
3'
Section to be poured
Canvas
Oil stoves
Coldest temp. outside 30°F (30° below zero)
1"Boards used to hold canvas steady during wind
4'
4'
Fire pots
Tin roofing sheet to protect forms from heat
Salamander or fire pots

FIG. 30—ELABORATE FORM OF PIER PROTECTION

tions above ice level the best protection is afforded by a housing built around the forms so as to leave a 2½-ft. annular space in which steam radiators are installed. To protect the top surface, emergency heaters were set on inside brackets around the forms; these were seldom found necessary. Thermometers kept the foreman aware of the temperature. The outside housing consisted of 2 x 6-in. studding spaced 2½ ft., covered with 1-in. boards, and these with two layers of building paper battened on. This protection, with the other devices indicated by the drawing, was found ample at temperatures going frequently to —40 deg. A 10- to 12-hp. boiler at each pier gave ample steam with the exhaust from the hoists. The cost of protection such as indicated will average from 60c. to 70c. a cubic yard. On other piers under less severe frost conditions, a housing of canvas on frames was employed. (A. M. Bouillon, engineer.)

Protecting Bridge Arches and Slabs—In the bridge at Waterloo, Iowa, previously referred to, the under arch was protected as follows: Under the spans the arch openings from ground to arch ring were closed with tar paper on the outside falsework posts on each side and the enclosure was heated by salamanders. Some notable observations of concrete temperatures were obtained on this work as detailed in Table III (article 6). A similarly neat protection was employed in 1926 at Galt, Ontario, on a slab bridge of two 15-ft. spans 47 ft. wide; the clearance above-stream was about 4 ft. Two small mixers were used, one at each end, each with an adjacent gravel stock pile and water barrel, both heated by steam jets from open-end pipes; concrete left the mixers at 80 deg. Abutments and center pier, all plain walls, were protected by a steam pipe along the top and on each side outside the forms, and all were covered for three days with canvas. Forms were struck in ten days. The slabs were laid in two days' runs, one span each day. Above each span slab were set on supports two square coils of steam pipe with the free ends turned over the edges and underneath the span the sides of which from slab to water level were inclosed with roofing felt nailed onto the falsework. The pipes were covered with manure and canvas and kept hot with steam for two weeks. The concreting temperatures were 28 to 32 deg. (Galt Board of Works.)

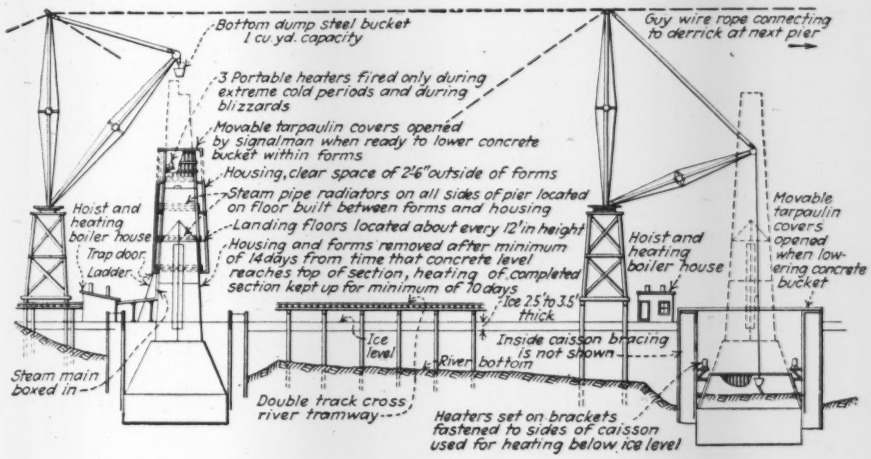

Bottom dump steel bucket 1 cu yd. capacity
Guy wire rope connecting to derrick at next pier
3 Portable heaters fired only during extreme cold periods and during blizzards
Movable tarpaulin covers opened by signalman when ready to lower concrete bucket within forms
Housing, clear space of 2'6" outside of forms
Steam pipe radiators on all sides of pier located on floor built between forms and housing
Landing floors located about every 12' in height
Housing and forms removed after minimum of 14 days from time that concrete level reaches top of section, heating of completed section kept up for minimum of 10 days
Hoist and heating boiler house
Trap door
Ladder
Hoist and heating boiler house
Movable tarpaulin covers opened when lowering concrete bucket
Ice 2.5' to 3.5' thick
Ice level
Inside caisson bracing is not shown
River bottom
Steam main boxed in
Double track cross river tramway
Heaters set on brackets fastened to sides of caisson used for heating below ice level

FIG. 31—PROTECTION USED ON LAKE HUMPHREYS DAM

Dam Protection—Dam construction has called generally for rather simple methods of protection, dependence being put on the hot mix and the chemical heat generated in the heavy concrete sections to prevent frosting. On several of the largest winter dam operations of recent years, the only protection has been (a) canvas on light framework or staging to roof over tops of forms being concreted; (b) canvas curtains dropped down over the forms outside; and (c) heating the canvas enclosures by steam jets or salamanders. Arrangement of inclosure, the space inclosed and the location and number of heating units are in each case a separate problem, and require careful study and then careful checking by thermometer readings.

In building the Lake Humphreys dam in Colorado, a rather thin arch structure, the inclosure and heating arrangement indicated by Fig. 31 was employed. Briefly, the cold weather work plan was: (1) Sections concreted 45 ft. long and 12 ft. high; (2) forms for section completely covered with heavy canvas; (3) eight oil heaters placed under canvas at base, three on each side, and one at each end; (4) eight fire pots spaced like oil heaters hung 8 ft. below base of canvas and having wood fires; (5) open fires in bottom of canyon above and below dam, heat being carried up the faces and over the top by the wind; (6) flooding the top of the concrete with warm water and letting it drip down the outside; this flooding was carried on for 48 to 72 hours. (Carl A. Gould, engineer.)

Effect of Different Kinds of Pipe on Quality of Water Supplies

By H. W. Clark
Chief Chemist, Massachusetts Department of Health, Boston, Mass.

Author's summary of a paper before the New England Water Works Association, Vol. XLI, No. (1927).

SUMMARIZING the results of these investigations it is evident that whatever pipe is used a certain amount of metal will be taken into solution by the water and this amount varies under different conditions and with different waters; that if the pipe is iron a greater amount is taken than from a pipe of any other metal.

Galvanizing an iron pipe prevents to a large extent and for a considerable period the absorption of iron but much zinc is continually taken into solution in the water as long as the galvanizing lasts.

Tin-lined pipes are awkward to handle from a plumbing point of view but little tin is taken from them by any water.

Brass pipes yield much zinc but generally only minute amounts of copper. Copper pipes yield about the same amount of copper as the brass pipes but zinc is not involved in the corrosion of these pipes except occasionally, certain copper pipes seeming to contain a small amount of zinc which readily dissolves.

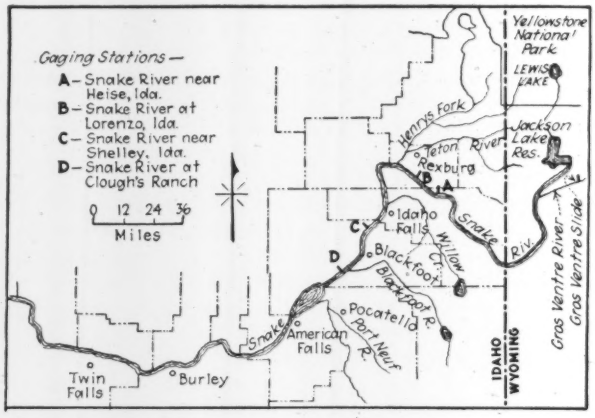
We know from experience in this state that lead in average amounts of 0.04 of a part in 100,000 in drinking water will cause lead poisoning of certain individuals if habitually used. Occasional statements have been made by certain investigators in regard to the harmfulness of zinc when present habitually in amounts greater than 2 or 3 parts in 100,000. We have no recorded instances of intestinal or other troubles from zinc in water although this zinc is present in large amounts in practically all waters passing through galvanized-iron pipes. It seems hardly possible that the small amount of copper taken generally from brass or copper pipes can cause illness but probably every house piping system should be well flushed out each morning in order that the water which has stood in the pipes overnight may be removed.

In some of this work minute amounts of copper were found in ground and surface waters which had not passed through copper pipes. This is not a cause for surprise as the human system always contains copper taken in with food and of course it is being constantly removed from the system. Shell-fish, especially oysters, contain considerable copper and such grains as wheat, barley, etc., also contain copper which must come from the ground. Brass strainers on driven-well systems also yield copper and zinc.

Further Data on Failure of the Gros Ventre "Dam"

Disastrous Slip of Earth Barrier on River in Wyoming Stresses Need for Care in Grading Earth Dam Material

THE GROS VENTRE River is a small tributary of the Snake River, the confluence being about 41 miles south of Yellowstone Park in Wyoming. On June 23, 1925, it came suddenly into prominence when a landslide swept earth and rocks down the mountain side and blocked the river channel, forming a dam about 1½ miles thick through the base and some 4,000 ft. long on top. (See *Engineering News-Record*, Sept. 17, 1925, p. 467.) This natural barrier was carefully examined by engineers and others but even though the water behind it accumulated to a depth of some 100 ft. its thickness and apparent stability were such that no fears were entertained as to its safety; people continued to farm the land and live in the valley towns below.



RELATIVE LOCATION OF SLIDE AND GAGING STATIONS

On May 18, 1927, a portion of the material forming the barrier gave way and was carried out by the impounded water with such suddenness that a flood swept down the valley, causing the death of six persons and very extensive property damage. (See *Engineering News-Record*, May 26, 1927, p. 878.) This event is regarded as stressing the importance of grading the material used in earth dams. Interest therefore centers in the conditions obtaining in this barrier at the time when the flood was released. The accompanying pictures were supplied by and the following data have been compiled with the aid of G. Clyde Baldwin, district engineer, U. S. Geological Survey, Idaho Falls, Idaho.

VIEW AT DEEPEST POINT IN CHANNEL THROUGH BARRIER

Dark ridge in left center marks crest prier to failure. Note recent small slide in right center.

After the original slide occurred in 1925 the lake filled rapidly to within 20 or 25 ft. of the lowest point of the barrier crest. Before this elevation was reached, however, water began to seep through the barrier, chiefly at an elevation about two-thirds of the height. This seepage was sufficient to care for the entire flow of the stream from that time until shortly before the break. In this connection it is to be remembered that the snowfall during the winter of 1925-26 was well below normal, with the result that the 1926 flood runoff was much less than in the average year.

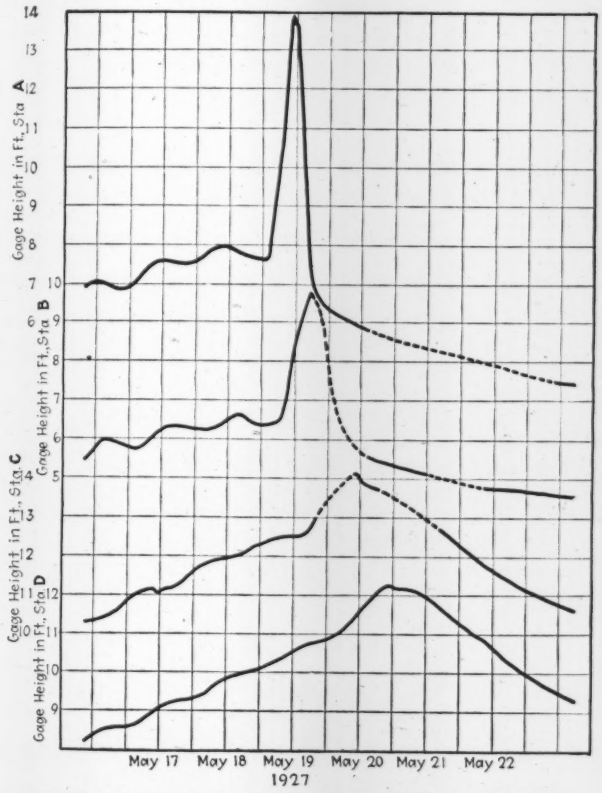
IN THE CHANNEL THROUGH THE BARRIER

Note fines in side banks. This view was taken a short distance upstream from the deepest point in the cut.

During the winter of 1926-27 the lake level dropped about 16 ft., but the spring freshets of 1927 not only exceeded the rate at which water could seep through the barrier but filled the lake practically to crest level.

At any rate, there was a thorough saturation of the lighter material in the barrier, which is believed to have consisted not only of clay but also of humus and some vegetable matter. Under these conditions the break that occurred about 11 o'clock on the morning of May 18, 1927, is believed to have opened up the channel very rapidly. This channel is now about 100 yd. wide and 100 ft. deep through the southeast portion of the barrier and the distance through the barrier along the present stream channel is estimated to be about 1,800 ft. Mr. Baldwin makes a rough estimate that the amount of material carried out at the time of the break was more than 500,000 cu.yd. As the result of this sudden release of water the lake level was quickly lowered about 45 ft.

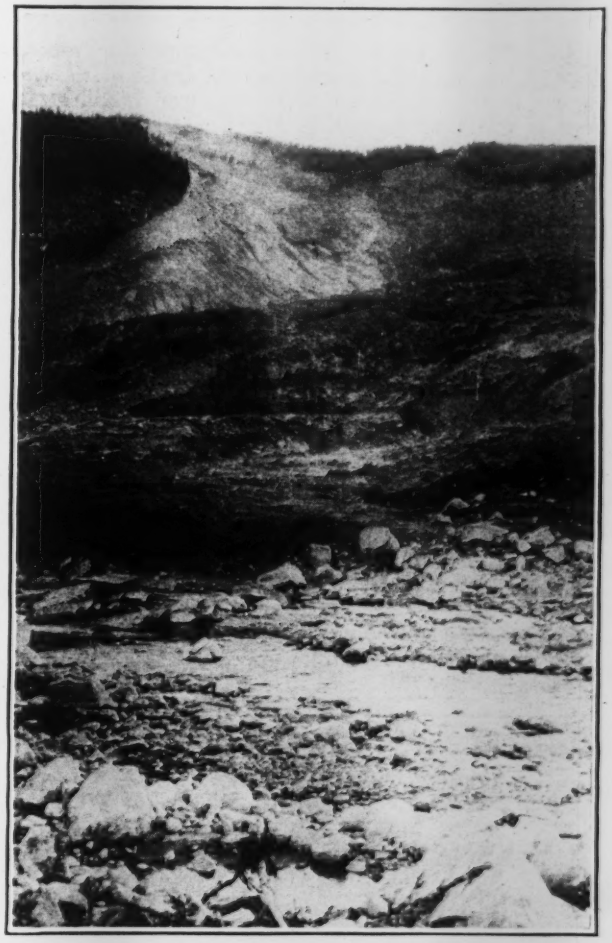
Both the slide material and the banks of the channel through the barrier show a considerable amount of clay and contain individual rocks whose size was estimated to



RIVER STAGE RECORDS AT FOUR GAGING STATIONS

vary from 20 to 60 cu.yd. The major portion of the rock, however, is much smaller, as indicated in the accompanying pictures. Apparently some float ledge rock from the hillside above occurs in the barrier, but any of this in the channel where the break occurred must have been resting on a clay base. The material on the south side of the break contains more dirt and clay than that on the opposite side, which suggests a reason for the occurrence of the break in this part of the barrier.

The amount of water that went out through the break is now believed to have been about 60,000 acre-ft., leaving about 25,000 acre-ft. in the lake at the present level. The marks of the flood indicate that the maximum rise at the town of Kelly, three miles below the dam, was 20 ft. Forest Supervisor McKain, at Jackson, who reached Kelly on his way upstream just in time to see the main flood wave strike that little village, reports that before this wave arrived there had been a more gradual rise amounting to 4 to 6 ft. On Sept. 3, when Mr. Baldwin was at the barrier, there was at least one point



LOOKING ACROSS THE CHANNEL AND UP THE SLIDE
The stream flow was about 275 sec.-ft. when this picture was taken Sept. 3, 1927.

on the north side of the present stream channel where a considerable amount of seepage was appearing on the downstream face. This suggested that under the greater pressure due to the higher lake level before the break there may have been extensive seepage at various points.

The gage reading at Heise station, 110 miles down the river, indicated that the rate of flow there was about 60,000 sec.-ft. at maximum discharge. Unfortunately, the discharge reading at that point cannot be stated exactly because the flood destroyed the remainder of the old Anderson dam just below the gage station, which affected the gage heights at this point.

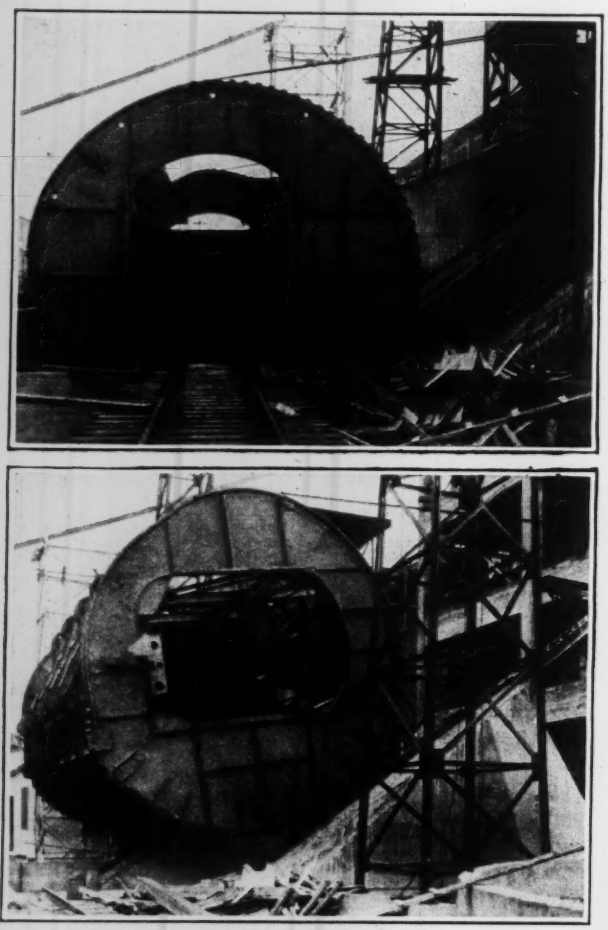
Some interpolations were also required in the gage readings of other stations due to the choking of inlets by the unprecedented quantity of drift that was carried down by the flood. However, compiling the available data as accurately as possible, the changes in stage at several gaging stations below the dam are shown in the accompanying diagram.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Car Dumper Installation of Unique Design

INSTEAD of being revolved upon equalizing rollers carried in structural steel bases, the cradle of the car dumper installation shown in the accompanying illustrations is rolled up an incline. Such a design was dictated by conditions and requirements at the site of the plant of the Florida Portland Cement Co., Tampa, Fla., where the installation is located. The usual storage bins beneath the dumper were not required, only enough storage for a day's use at the crusher plant being necessary; by rolling the dumper up an incline, sufficient storage was provided for this purpose.



CARS DUMPED BY ROLLING CRADLE OF DUMPER UP INCLINE

Upper view shows cradle in upright position. Lower view shows cradle halfway up incline.

The steel girder runways are inclined at approximately 35 deg. and the machinery for rolling the cradle up the incline is mounted on foundations at the ground level under the crusher tower. A 115-hp. motor fitted with a geared limit switch is used to slow down and stop the rolling of the dumper in either direction. Through double-reduction gearing, this motor drives two drums spaced 50 ft. center to center and carrying the operating cables.

The car clamps are of the pivoted counterweight type, there being four clamps provided for holding the cars in position during the dumping and return cycle of the cradle. Each clamp has its own independent operating mechanism, all of which is carried at the rear of the dumper so that there is unobstructed dumping except for the narrow clamp beams themselves.

This dumper will handle open-top railway cars from 7 to 12½ ft. high, 9 to 10½ ft. wide and 50 ft. long, having a loaded weight of car and contents of 220,000 lb. It is stated that cars with 80-ton capacity of rock, plus approximately 10 per cent overload and a tare weight of 45,000 lb., can be dumped at the rate of 20 cars per hour. The dumper was designed and constructed by the Wellman-Seaver-Morgan Co., Cleveland, Ohio.

Concrete Road Finishing Machine Used on Asphalt Paving Work

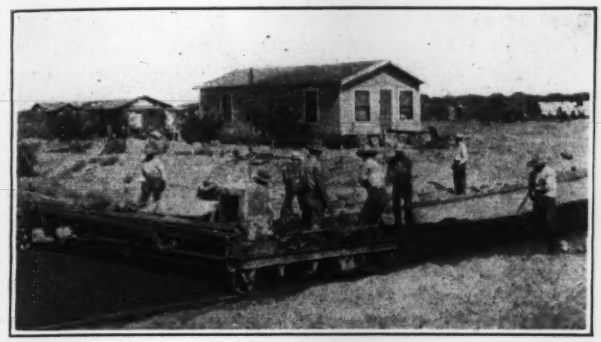
SPREADING and raking of asphaltic concrete in road work has almost always been a hand job. On some work in California, however, the contractor decided to substitute for manual methods mechanical spreading and raking, using his concrete finisher not then in use.

The work consisted of sixteen miles of 18-ft. two-course asphaltic concrete, with 2½-in. and 3½-in. base course, 1½-in. top course, and a seal coat covered with chips. A 6-in. decomposed granite sub-base was first laid, using 3-in. wood forms. The height of the forms above sub-base equalled the thickness of the asphalt base course. Before starting the work it was first necessary to determine the amount of compression under rolling. This on a 3½-in. base was $\frac{5}{8}$ in. and to allow this extra thickness a $\frac{5}{8}$-in. x 3-in. strip of wood was tacked to the top of the rail.

When laying the top course three strips 1½ in. x 3 in.

SPREADING ASPHALTIC CONCRETE FROM TRUCK

x 20 ft. were tacked to the form on each side, with sections of ⅜-in. x 3-in. flat iron laid on top to allow for compression on the top course. These iron strips had legs welded on each side to prevent them from being forced off by the screeds. As fast as asphalt was spread and screeded by the finishing machine these strips were removed and laid ahead.



LEVELLING ASPHALT WITH CONCRETE FINISHER

Some of the results obtained by the use of a finishing machine for spreading and raking are, according to the contractor, shadow spots in finished pavement were practically eliminated; only a small amount of segregation of mix was noted while laying and screeding, eliminating the working of stone to the top, as in hand raking; the thorough compacting resulting from the screed action reduced the rolling materially; and a true crown was maintained with a riding quality comparable to the best of concrete roads. It was also noted that with finer aggregates better results were obtained. No trouble was experienced in keeping the screed hot as it was never removed from the slab, and before starting in the morning it was thoroughly oiled.

The work was a contract constructed by the Griffith Paving Co. at Placentia, Orange County, California. Nat Neff, county highway engineer, in co-operation with A. P. Kendig of the Raymond G. Osborne Laboratories and Engineer S. B. McCulloch, had charge of field work. The Griffith company installed an organization which it estimated would complete the job in five months. By using mechanical means of spreading the time was reduced to three months with the same organization.

Earth Dam Makes Reservoir for Storing Crude Petroleum

IN THE hills back of Taft, Calif., a storage reservoir has been developed by the construction of an earth dam 64 ft. high. The reservoir is not large, as water-supply projects go, but it is unusual in that its function is the storage of crude oil from nearby wells. The structure was designed as an ordinary earth fill dam with rather steep side slopes and without any special provisions that would not have been used for water storage. As a safeguard against fire danger the area is guarded continually by watchmen.

DOWNSTREAM FACE OF THE OIL STORAGE DAM

Placing 36-in. Pipe in 150-ft. Sections Saves Time and Cost

IN LAYING the recently completed 17-mile El Capitan pipe line from the Riverview pumping plant to the city of San Diego, Calif., a scheme was developed for placing the pipe in the trench at a considerable saving in time and cost as compared to the usual method. The line consists of 36-in. lock-bar steel pipe, ½ in. thick wrapped with soil-proof covering and delivered along the trench in 30-ft. lengths.

In preparing to lay this pipe five 30-ft. sections were riveted together in a unit alongside the trench and this 150-ft. unit was then lowered into the ditch by two derricks mounted on crawlers. The location of this line was through country such that the crawlers could move

PLACING 36-IN. PIPE IN 150-FT. LENGTHS

continuously along the ditch and derricks were used which could easily handle the 18-ton (approximate) weight of each unit.

This method made it unnecessary to excavate bell-holes in the trench except at points where the 150-ft. units were riveted together in the trench. There was also the saving that the riveting up of the 30-ft. sections alongside the trench was done much more speedily than would have been possible had riveting crews been obliged to work in bell-holes in the trench.

The pipe was supplied and the work done by the Western Pipe and Steel Co. to whom *Engineering News-Record* is indebted for the foregoing information.

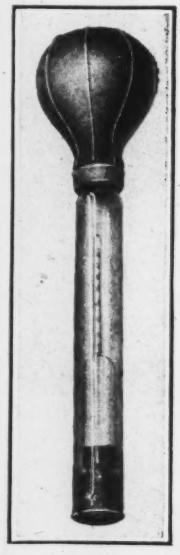
From Job and Office

Hints That Cut Cost and Time

Rapid Test for Water Content of Damp Aggregates

By Tappan Collins
Dravo Equipment Co., Pittsburgh, Pa.

THE presence of fluctuating quantities of moisture in concrete aggregates is the source of many inaccuracies of concrete control. Uniform moisture content of the fine aggregate may be approximated by inundation, if the voids are reasonably constant throughout the job. Even with inundation, and fairly constant voids, varying water content of the coarse aggregate must be compensated for if control is to be accomplished. Nor is it ever sound practice to assume constancy of voids; their value should be checked from time to time to assure a known water measurement.



APPARATUS FOR DETERMINING MOISTURE CONTENT OF AGGREGATE

Existing means for measuring the quantity of free water carried by moist aggregate have been so time-consuming and have involved so much computation that they are seldom employed except as a remote and infrequent check. The following method has been developed to provide a simple, rapid and direct-reading means for determining the moisture content, or water of inundation, of any reasonably clean aggregate. The single instrument required is inexpensive and small and cannot get out of adjustment. Readings can be made on aggregate samples in a few seconds' time, without computation or correction for absorbed moisture within the aggregate particles. With sands and gravels that are reasonably clean the readings are reliable to within less than $\frac{1}{4}$ lb. of water in 100 lb. of moist aggregate. This limit of accuracy is, of course, greater or less depending upon the extent of soluble impurities in the aggregate. Most aggregates, if at all suitable for concrete use, are almost wholly free from soluble impurities.

The apparatus employed is shown in the accompanying illustration and consists of a hydrometer, the stem of which is calibrated in gallons, and a glass syringe with rubber bulb and perforated rubber cork, over which a gauze filter is fastened by a rubber band. The hydrometer is placed within the syringe and readings are taken as with an automobile battery tester. Three drawn points on the hydrometer float keep the float free from the syringe wall and eliminate the sluggishness and error due to tension within the liquid. They also afford frictional resistance to turning and permit the hydrometer to be rotated to bring the scale into convenient view of the operator.

A quantity of saturated solution of common salt in water is prepared in advance, and kept on hand for the tests. So long as the solution is kept saturated, temperature changes will not affect its specific gravity. The solution can be checked to insure saturation by sampling with the hydrometer syringe, the hydrometer being calibrated to give a zero reading with a saturated solution. This check should be made before beginning a test.

If one volume of saturated solution is mixed with an equal volume of the damp aggregate, and a reading taken on the resulting dirty liquid, the hydrometer will indicate directly the number of gallons of free water contained in each cubic foot of the damp aggregate. If 1 lb. $10\frac{3}{4}$ oz. of damp aggregate is employed with each 1 pt. of solution the reading will express gallons of free water in each 100 lb. of damp aggregate. The former is the more simple test, for the same measure may be used for obtaining the aggregate sample and the solution. The latter is the more accurate test for fine aggregate because it is difficult to duplicate the condition of compacting in the batcher when employing a small sample.

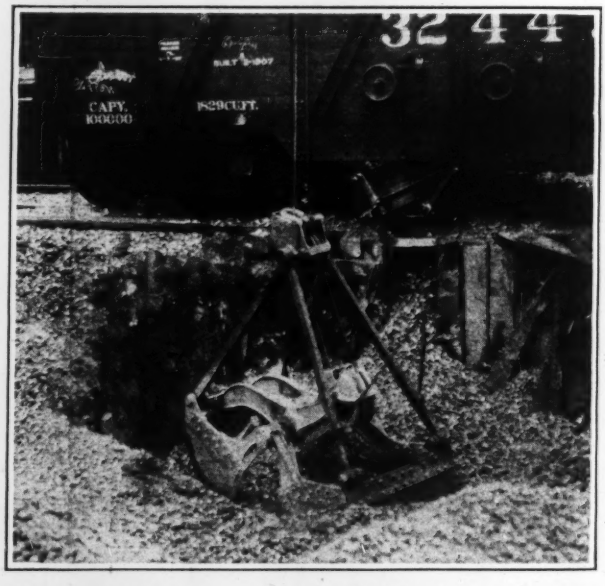
The discoloration of the resulting liquid is of no consequence because it is due solely to suspended matter and does not affect the specific gravity of the liquid. The saturated solution is quite deliquescent and takes into solution the moisture contained in the aggregate almost instantaneously. Repeated tests with air-dried material indicate that it does not receive into solution the absorbed moisture, hence no correction for absorbed moisture is necessary.

The method and instrument are covered by application for United States letters patent.

Improvised Track Pit Unloads Cars With Hopper Bottoms

By J. L. Harrison
Bureau of Public Roads, Washington, D. C.

WHERE flat-bottom cars cannot be had in sufficient number to keep up material supplies, bottom-dump cars can be cheaply and easily used by digging a fairly good size pit at the side of the track and taking material from this pit. Usually, one tie must be removed and the trench cut under the car lined with good plank. A little cribbing may be desirable though as in the case illustrated the cribbing may be of light construction.



IMPROVISED TRACK PIT FOR HOPPER-BOTTOM CARS

From Job and Office

For Contractor and Engineer

The crane will dig the pit in a short time, all that is required being depth enough to permit free flow from the car plus a couple of feet in which enough stone can be carried so that the bucket will not pick up dirt.

The method is faster than working from the top of the car as a full bucket can be had with less manipulation. It also prevents damage to the cars and avoids a good deal of damage to the bucket.

Machine Cuts and Tenons Piling

FOR pier, wharf or bridge construction where the use of wooden piling is extensive enough to warrant employment of such expensive equipment there has been erected a specially designed machine which not only rapidly cuts off the piling at a given elevation, but tenons them as well.

The machine is essentially a gantry running outside

MACHINE FOR TENONING AND CUTTING PILES

the pile area, and with a span of around 58 ft. A cab on the bridge is driven by a 5-hp. motor. The cab contains a 50-hp. motor for driving the cutoff and tenon saws, whose 2-in. shafts are fastened to a trussed steel frame and suspended from the cab. With such mobility a large area can be covered both laterally and longitudinally in a short time. Universal couplings are used to provide for rapid removal or mounting of any saw.

Motion is imparted to two spindles operating in a horizontal plane, each spindle carrying two saws. The top saws run almost edge to edge, each saw cutting the pile from the periphery toward the center. The lower saws are of smaller diameter and of dimensions suitable to allow the cutting of the tenon to the desired width. Two vertical saws, mutually displaced at a distance equal to that of the desired tenon, follow the aforementioned saws so as to cut away the material remaining after the saws have passed, and thus leave the desired tenon. To allow for adjustment of the center-to-center distance between saws, which may be necessary owing to wear, self-aligning couplings may be employed to transmit the rotation of the saw spindles. The lower part of the saw-mount is hinged to the upper part to aid adjustment.

A patent on this machine has been taken out by its designer, Joseph M. Wumsch, chief engineer of the Silent Hoist, Winch & Crane Co. It has been used successfully on work in Philadelphia by the Arthur McMullen Co.

Construction Railway Has 50-Deg. Slope

By Daniel McFarland
Storrie, Calif.

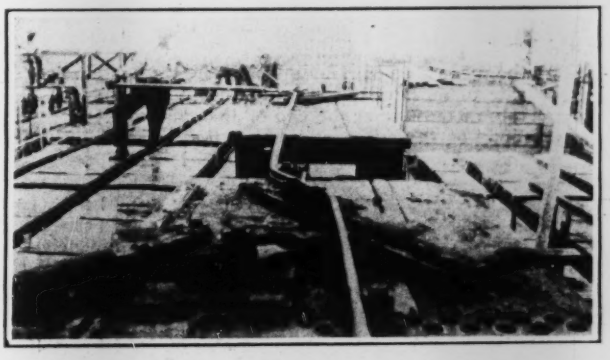
A STANDARD-GAGE double-track cable railroad was constructed in connection with the Feather River Canyon hydro-electric project, in which the average slope is from 30 to 35 deg. and the maximum slope is 50 deg. This railroad was used to carry supplies to a point 2,460 ft. above the river, where a tunnel was constructed.

The track consisted of three rails laid with standard spacing so that two cars could be used simultaneously. Due to the steepness of the slope, the rail was anchored at intervals to convenient stumps. The cars were fastened together by a 1½-in. plough-steel cable, which passed around a hoist drum and when one of the cars was at the bottom of the slope, the other was at the top. The cars tended to counterbalance each other as they traveled up and down. Halfway up the slope a turnout was provided, to permit the cars to pass each other. The turnout was made by welding each end of a fourth rail on one side of the center rail in the shape of a bow, and then making the outer rail on that side conform to the proper gage. The cars were ordinary flat cars of 15-ton capacity with standard-gage, flanged wheels. Stops were built at the low end of the cars for convenience in loading and carrying all classes of supplies. Loading platforms with cranes were provided at each end of the line.

The hoist consisted of a 5-ft. drum, around which the cable was passed six times. The drum had a large hand brake and was gear driven by a 200-hp., variable-speed motor. It was also provided with a magnetically-operated brake.

Job and Office Notes

AN APPARATUS FOR BENDING REINFORCING BARS has been developed on a construction job in California. Because of its success on this work, a patent has been taken out by A. S. Terhaar, Route 4, San Diego, Calif., who is now



offering it for sale. The machine consists of two parts, a right and left hand section each mounted on an 8-ft. loose top table. On each table there is bolted a ½x6-in. plate 8 ft. long drilled with 1-in. holes on 2-in. centers over its entire length. Pins placed in these holes as desired produce the required length of bend. A toggle arrangement for bending is operated by a long handle wrench, as shown in the illustration.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Pondage a Factor in Spillway Design

Sir—The article "Pondage Important Factor in Spillway Design" by Melvin D. Casler in your issue of July 28, 1927, p. 133, presents another method of computing the rate of outflow and corresponding height of reservoir from inflow and reservoir capacity.

Other methods of dealing with this problem have been published as follows:

"Irrigation Manual," Lieut. Gen. J. Mullins, published for the Madras Government in 1890. The formulas from this paper are also found in "Reports of the State Engineer and Surveyor of New York," 1894, pp. 390-392 and 1896 pp. 722-724.

"A Method of Computing the Size of Spillway for a Dam," by H. K. Palmer, *Engineering News*, March 21, 1912, p. 524.

"Determining the Regulating Effect of a Storage Reservoir," by Robert E. Horton, *Engineering News-Record*, Sept. 5, 1918, p. 455.

"Method of Computing Waste-Weir Capacity and Reservoir Rise," by W. S. Pardoe, *Engineering News-Record*, Jan. 20, 1921, p. 114.

"Computing Reservoir Outflow and Height from Inflow and Capacity," by J. C. Stevens, *Engineering News-Record*, Dec. 22, 1921, p. 1031.

So far as the writer is aware, his method cited above is the only one wherein the outflow is determined directly without the use of intermediate functions. Mr. Casler's method is simpler than many of the others but nevertheless involves the intermediate q and $s \div q$ function.

The writer is in receipt of a letter from H. H. Dare, M Inst. C. E. and a member of the Water Conservation and Irrigation Commission of New South Wales, in which he states "since my last communication I have had the advantage of applying your method to the investigation of a reservoir under flood conditions and I may say that it impressed me both with the ease of treatment and the accuracy of result."

The writer's formula gives the rate of outflow at the end of a chosen time interval which immediately becomes the known outflow for the beginning of succeeding time interval. **It is**

$$q = \frac{i}{\frac{m}{\Delta t}+\frac{1}{2}} + Q\,\frac{\frac{m}{\Delta t}-\frac{1}{2}}{\frac{m}{\Delta t}+\frac{1}{2}}$$

in which

i = the mean rate of inflow during the time interval Δt.
Q = rate of outflow at the beginning of that interval.
q = rate of outflow at the end of that interval.
m = slope of the curve expressing the relation between outflow and storage capacity. (See Fig. 1 of the author's article.)

To apply the formula it is only necessary to plot a curve of outflow and storage capacity, substitute for this curve a series of chords and find the slope of each chord which is used between certain values of the outflow, that is, one value of m is used until the outflow exceeds a predetermined amount, then another value and so on.

In the writer's article above cited the suggestion was made that the $\frac{1}{2}$ in the denominator of the first right-hand member could be dropped without appreciable error. This is generally true but retaining it at all times involves practically no additional labor and eliminates whatever error it may involve, which of course is greatest for long time intervals.

There are a number of typographical errors in that article which the writer would like to take this occasion to correct.

In the third line p. 1032, δt should be $\frac{1}{24}$ and the headings for the table should not be repeated.

In equation 9, p. 1032, a minus sign should precede the exponent $\frac{t}{m}$ before the integrating sign.

In equation 10 and in the first line of the succeeding paragraph the exponent of e should be

$$\frac{-\delta t}{m}$$

The writer would again call attention to the great simplification resulting from expressing inflow and outflow in second-feet, storage capacity in sec.-ft.-days, and time intervals in fractions of a day.

J. C. STEVENS,
Stevens & Koon, Consulting Engineers.

Portland, Ore.,
Aug. 8, 1927.

Sir—Herewith is a graphical solution of the flood reservoir problem outlined by Melvin D. Casler in your issue of July 28, 1927, p. 133.

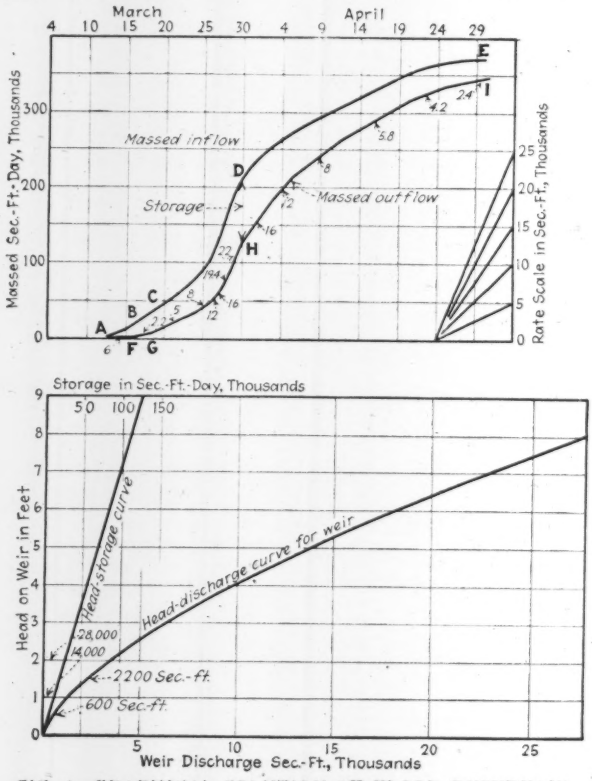


FIG. 1—GRAPHICAL SOLUTION OF FLOOD RESERVOIR PROBLEM

Curve *ABCDE* is a massed inflow curve, obtained from Table II, the ordinate being sec.-ft.-days (i.e. 86,400 cu.ft.) and the abscissa time in days. The ordinate at any point represents the total flow from March 13 to that date ex-

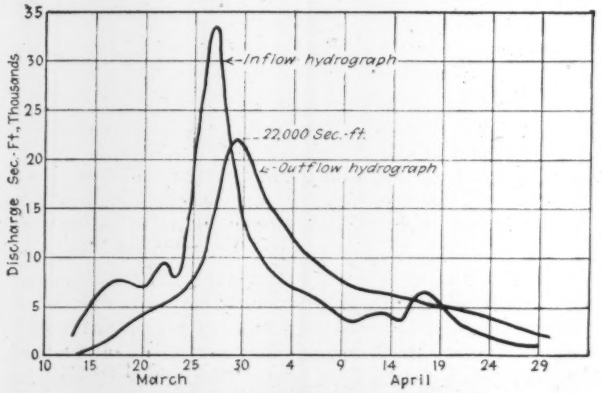


FIG. 2—RESERVOIR INFLOW AND OUTFLOW CURVES

pressed in units of 86,400 cu.ft. As the abscissa is time, the tangent or slope of the curve at any point is discharge in cu.ft. per second, the rate scale being shown on the diagram.

Curve *AFGHI* is a massed curve of outflow. The ordinate between it and curve *ABCDE* is storage. It is constructed as follows. During the period the reservoir is rising from 0 to 1 ft. the average outflow is 600 sec.-ft. Lay off from *A* the line *AF* representing this rate and continue it till the ordinate *BF* is 14,000 sec.-ft.-days (see curves for discharges and storage). During the time the reservoir is rising from 1 to 2 ft. the average outflow is 2,200 sec.-ft. and line *FG* is laid off representing this rate, being continued until ordinate *GC* is 28,000 sec.-ft.-days; and so on until line *AFGHI* becomes parallel to *ABCDE* at points *D* and *H*. This means the outflow equals the inflow, after which the outflow is greater than the inflow and the reservoir empties as indicated by the decreasing ordinate between the two massed curves. The maximum rise of reservoir is 7 ft. and the maximum discharge 22,000 sec.-ft. This checks with sufficient accuracy the result obtained by Mr. Casler. Curves showing inflow and outflow hydrographs are also submitted herewith.

SPILLWAY OVERFLOW ANALYSIS

REGULATION OF_____RESERVOIR
AS PER OPERATION CHART_____

$$(S_y + q_y) = (S_x - q_x) + F_{xy} \quad \text{Eq. (1)}$$

S_y = Storage above El. _____ ft. at end of day (B.C.F.)
q_y = Spillage rate at end of day (B.C.F. per ½ day)
S_x = Storage above El. _____ ft at beginning of day (B.C.F.)
q_x = Spillage rate at beginning of day (B.C.F. per ½ day)
F_{xy} = Reservoir inflow during day (B.C.F.)

1	2	3	4	5	6	7	8	9	2	3	4	5	6	7	8	9
	MONTH AND YEAR								MONTH AND YEAR							
DAY	NATURAL INFLOW SEC.-FT.	(S−q)	F	(S+q)	q	DAILY SPILLAGE BILLION CU. FT.	DAILY SPILLAGE SEC.-FT.	RESERVOIR WATER SURFACE EL.	NATURAL INFLOW SEC.-FT.	(S−q)	F	(S+q)	q	DAILY SPILLAGE BILLION CU. FT.	DAILY SPILLAGE SEC.-FT.	RESERVOIR WATER SURFACE EL.
1																
		(a) +														
2			(b)=													
		(e) +		(c)	(d)											
3			(f)=													
		(i)		(g)	(h)											
4																
30																
31																

Note—
Column 3 = 5-6-6
Column 4 = 2 x 0.0000864
Column 5 is obtained from equation (1)
Column 6 is obtained from _____
Column 7 is sum of adjacent q's
Column 8 = 7 x 11.574
Column 9 is obtained from _____

FIG. 3—SPILLWAY OVERFLOW ANALYSIS—CASLER

W. S. PARDOE,
Professor of Hydraulic Engineering,
Philadelphia, Pa., University of Pennsylvania.
Aug. 9, 1927.

Sir—With reference to the above letters:

The chief advantage to be cited in favor of the writer's method of spillway analysis as outlined in *Engineering News-Record*, July 28, 1927, is that it is a time saver.

A copy of the following tabulation form is filled in for each spillage period by the routine steps indicated. $a + b = c$; d is obtained from c by means of a (q) $(S + q)$ curve; $e = c\text{-}d\text{-}d$; $c + f = g$; h follows from g; $i = g\text{-}h\text{-}h$, etc., etc., the tabulation progressing quite rapidly. Column 9 is obtained from a (q) (water level) curve. For spillway periods extending through or into more than two successive calendar months the form is extended accordingly.

The writer takes this opportunity to state that the word "restricted" in the captions of Table III and Fig. 3 of the July 28 article should not have been used, and of calling attention to the following typographical errors therein:

Page 133, column 2, line 10, "*d*" should be "d_y."

Table I, columns 4 and 5, headings should be "*q*" and "$S + q$" respectively.

MELVIN D. CASLER,
Designing Engineer, Hudson River
Albany, N. Y., Regulating District.
Sept. 15, 1927.

Chloride and Other Salts in Colorado River Water

Sir—In your July 28 issue, p. 151, appears a note entitled "Salt Content of Colorado River Water" which says that "for an entire year the weighted average of results shows that the river transports per day 28,000 tons of dissolved solids, and has a mean discharge of 20,000 sec.-ft. (40,000 acre-ft. per day) so that the water carries about two-thirds ton of salt per acre-foot."

Examination of Water Supply Paper 596-B which is quoted as authority for this statement, discloses "that weekly composite analyses of the Colorado River water at Grand Canyon, Arizona, are given from August, 1925, to September, 1926." There is also given an analysis of all of these composite samples, and another analysis which shows the results of all the others in a weighted form which represents water from the Colorado River which might have been impounded representing a mixture of the entire year's flow of the stream. The chloride content of this weighted analysis is 56 parts per million, which, when converted to an equivalent amount of sodium chloride would mean 257 lb. of salt per acre-foot. This is a long way from being three-quarters of a ton. Incidentally, it is interesting to note that 56 p.p.m. is exactly twice the chloride content of our present Los Angeles municipal supply and, further, that this 56 p.p.m. is less than the sodium chloride content of many of the water supplies being used by the large cities of the United States.

The objection to the statement in *Engineering News-Record* above referred to is that the last sentence states that the water carries about two-thirds ton of salt per acre-foot, instead of expressing it as totally dissolved solids, which is misleading to many people. Many inquiries have come to this office from people in the community who are disturbed by the thought that the water would be too salty for use. It is pointed out that until the sodium chloride content is 250 p.p.m. it is not discernable to the ordinary taste; the 56 p.p.m. shown in this study are approximately one-fifth of that quantity.

H. A. VAN NORMAN,
Los Angeles, Calif., Assistant Chief Engineer and
Sept. 16, 1927. General Manager, Department of
Water and Power, City of Los Angeles.

[In our note the term "salt" referred to all dissolved solids, not merely the sodium chloride. The context was believed to make this clear. It should be added that the figures were reproduced by us primarily for their bearing on irrigation rather than domestic use of the water.—EDITOR.]

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Am. Soc. C.E. Aids City's Engineers in Salary Problem

Secretary Seabury Directs Attention of New York Board of Estimate to Salary Inequities

FORMAL assistance has been given the engineering employees of the city of New York in their endeavor to get salary increases by George T. Seabury, secretary of the American Society of Civil Engineers. Pursuant to the action of the Board of Direction of the society Mr. Seabury has transmitted to the Board of Estimate and Apportionment of the city of New York a statement wherein he sets forth the inadequacy of salaries, the impairment of city engineering functions by such a condition and expresses the hope that the Board of Estimate in its present budget-making will adjust the salary matter in accordance with the schedules prepared by the chief examiner of the Municipal Civil Service Commission (see these columns last week).

In his letter of transmittal to the Board of Estimate Mr. Seabury asserts that "Upon your engineers you rely for technical advice as to the practicability and utility of stupendous projects. Upon them, and upon them solely, you rely for the physical integrity of structures absolutely essential to the business life of the city, and thronged with its citizens; upon your engineers you rely for the honorable and efficient expenditure of millions of dollars. Impairment of your engineering departments, therefore, *must* be a matter of concern and your earnest consideration of the request is respectfully urged."

In the memorandum sent the Board of Estimate, Mr. Seabury says:

It is the function of the engineer to visualize the economic merit of proposed programs (which in the city of New York mount into millions and perhaps into billions of dollars). It is his function to visualize not only the program as a workable whole but also to comprehend the fundamentals of the infinitude of details incident to an adequate development of such programs. His work must be adequate as to economy; adequate as to technical design; adequate as to effective prosecution. On his ability depends the security of both property and life. Of him one demands a structure both safe and sound, a structure that will endure. It is his function to know that what is to be done, can be done. It is his function to know how it best can be done. It is his function to see that it is done. In this latter capacity he supervises workmen and to compare his salary with that of the workman is proper.

On June 9, 1927, the Board of Estimate and Apportionment of New York City adopted a resolution establishing, in all city departments, grades of positions and salaries for bricklayers, masons, metal workers, electricians, machinists, and the like—94 such grades, and by resolution of the Board the average salary of these 94 grades was placed at $10.64 per diem on the basis of a minimum of 277 days per annum. On the same basis the average salary of the engineers in the employ of the City of New York will be found to equal but $9.38 per diem. $10.64 for the mechanics as compared with $9.38 for the engineers!

Including the salary of the chief engineer, charged with the design of subways to cost some $600,000,000; including the salary of the chief engineer of a program of water development that will cost approximately $300,000,000; including the salary of the chief engineer of the Board of Estimate and Apportionment itself, an official whose duty it is to advise that body with respect to anything and everything of an engineering nature carried on or proposed to be carried on by the City; including the salary of the chief engineer of the Department of Water Supply, Gas, and Electricity—by far the largest municipal operation of its kind, or perhaps of any kind, anywhere in the world; including the salaries of the chief engineers of the several boroughs, their deputies and assistants; the average salary of the technically trained engineering employee is to that of the mechanic as $9.38 is to $10.64. The engineer plans, he directs the mechanic's work, but he does not receive his pay. With respect to 16 classifications of "foremen," he stands as $9.38 is to $12.47 and it is only with respect to "helpers," boiler firemen, and the like that he finds his pay not to be exceeded. Such a disproportionate relation is inequitable.

Pay Entirely Inadequate

The City of New York stands today in the position of remunerating its technically trained engineering employees so inadequately that those who have the necessary training and experience to carry on the city's work and who in times past have done so with energy and loyal enthusiasm are now, too many of them, sadly discouraged. They are leaving the city's employ. Their accumulated experience is lost to it but, what is worse, no new men can be found who are willing to take their places. The future will reap the harvest of the present penury.

The future! What matters the future to the "Powers that Be?"

It matters much. To the astute office holder in our large cities today the future is as important as the present or the past. To him the administration of office is his life-work and with care for his future he will see to it that there shall not fall upon him the opprobrium of works poorly conceived or improperly executed.

He demands of his engineer advisers absolute integrity of thought and high proficiency in technique. He demands much—he must pay proportionately—or suffer the consequences.

New York City Transit Report Made by Smith

Consulting Engineer Recommends Fare Increase and Continuance of Company Operation

FOLLOWING closely on the heels of the report by Samuel Untermyer, a lawyer on "unified transit system" for New York City, noted briefly in these columns Sept. 29, 1927, p. 526, comes a report on the same general subject but very different in tenor by Charles E. Smith, consulting engineer, St. Louis, Mo. Mr. Untermyer's report was made as special counsel for the Transit Commission and advised recapture by the city of most of the subway lines operated by private companies and their combination with subways now under construction by the city.

Mr. Smith proposes that there be a complete unification of all transit lines—subway, elevated and surface—with universal transfers but that the two great transit companies be left to operate their lines and that in place of a 5-cent fare, there be a sliding scale fare adjusted to meet the necessities of the case, as Mr. Smith sees them, the initial rate to be 7 cents or four tickets for 25 cents.

Mr. Smith also advises postponement instead of the needed recapture of subway lines, the latter proposed by Mr. Untermyer. He goes farther than that. Expressing the belief that the subway system now under construction by the Board of Transportation will cost $170,000,000 in excess of the Board's estimate, or a total of $842,000,000, Mr. Smith asserts that as much transit relief could be obtained by the expenditure of only $300,000,000 on the new subway lines by the Board.

Report Lengthy

Like the Untermyer report, the Smith report is very lengthy and involved in a multiplicity of details not readily followed by anyone not familiar with transit conditions in New York City. As to the fact of there being two reports, it may be explained that the Transit Commission, to which Untermyer reported as special counsel, is under legislative mandate to submit a transit plan for Greater New York, which plan has to be approved by the Board of Estimate and Apportionment of the city before being put into effect. Hence the engagement of Mr. Untermyer by the Transit Commission. The engagement of Mr. Smith comes through the Comptroller

of the City of New York, who is a member of the Board of Estimate and who was authorized by the Board to spend $25,000 to obtain a report. Mr. Berry, the Comptroller, chose Mr. Smith from a list of five engineers recommended at his request by the Board of Direction of the American Society of Civil Engineers. Besides a special consulting engineer, Mr. Berry requisitioned the services of a Citizens Advisory Committee of four members, among whom was the late E. H. Gary of the United States Steel Corporation. Apparently it was not the intent of Mr. Berry to have Mr. Smith's report given out until after it had been submitted to this Advisory Committee, but because of the enterprise of certain newspapers this was done. It is unlikely that any specific action on either report will be taken for a long time, but both will afford subjects for much discussion during the coming election campaign. At the November election the people of the entire state are to vote on a constitutional amendment authorizing the exemption of $300,000,000 of subway bonds from the debt limit of the city.

Both the Untermyer and Smith reports are largely devoted to the great question under dispute in New York City for years past, which is whether 5-cent fares on the subways and other transportation lines shall be continued. Mr. Untermyer says they should and Mr. Smith says they should not be. Mr. Smith urges that poor service and financial troubles in New York City's transit have been due to the low fare and because of this and to meet the problems of the future, advocates an increased fare as already stated.

PRAISES SYSTEM

In opening his report Mr. Smith makes an eloquent tribute to the "rapid transit system of subways and feeders that has been provided in New York City" in less than 25 years and which he characterizes as "a miracle of modern science". He says: "This is true of the design and construction of the facilities, the perfection of equipment and power, the frequency and the regularity of train operation, and the cheapness of the service. No other mechanical achievement approaches this in magnitude and complexity." As contrasted with this, Mr. Smith goes on to say: "Yet the operation of these facilities as two separate entities, the construction of more subways to be operated as a third, the separation of these from the necessary Manhattan Elevated System and the operation of numerous other transit entities, resulting in multiplication of fares and inconvenience to the public, constitutes an abortive anachronism." He proposes that "these facilities should be co-ordinated into a single unified system at the lowest self-supporting fares and with transfers among the various agencies of transportation on as favorable a basis as can be supplied". "Owing to the congested condition of the subways," Mr. Smith states, "the companies operating them do not

(Concluded on p. 610)

New York University Offers Accident-Prevention Course

The Extension Division of New York University in co-operation with the American Museum of Safety announces a course in accident prevention for the current scholastic year. The course is especially designed for safety engineers and public safety directors. C. W. Price, consulting safety engineer, and former director of safety of the International Harvester Co., and general manager of the National Safety Council, is in charge of the course. Other officers of instruction are Dr. E. George Payne, professor of educational sociology, New York University; Louis Resnick, formerly director of public information and education of the Welfare Council of New York, and director of publicity of the National Safety Council; W. Graham Cole, director, Safety-Metropolitan Insurance Co.; and C. S. Carstens, safety engineer of the Metropolitan Life Insurance Co.

The course will concern itself principally with industrial safety, public safety and motor-vehicle safety. The class meets for a two-hour session at 7 o'clock Monday evenings, beginning Oct. 3.

Progress Toward Two More Toll Bridges on San Francisco Bay

The San Francisco Bay Toll Bridge Co. has been incorporated with a capital of $2,500,000, according to an announcement made last week, to build the bridge across the southern arm of San Francisco Bay between Little Coyote Point in San Mateo County and the Alameda shore. Announcement of approval on this project by the War Department appeared in *Engineering News-Record*, Sept. 8, 1927, p. 406.

Construction on this bridge is to begin within a few weeks, the announcement states, financing having been completed. The estimate for the cost of the bridge is $7,500,000, exclusive of land purchases and highway feeders which are expected to bring the total overhead cost to about $10,000,000.

A. W. Deuel is chief engineer of the project.

In recent months, plans have been prepared and further location and traffic studies have been made on the proposed highway toll bridge across the strait between Point San Pablo and the Marin shore in the northern part of San Francisco Bay. A franchise application on this bridge is now pending before the supervisors of Contra Costa County, Calif. Previous reference to the project appeared in *Engineering News-Record*, Mar. 24, 1927, p. 503.

This location is about 12 miles below the recently completed Carquinez toll bridge and the proposed structure will include four cantilever spans totaling about twice the length of the Carquinez bridge. The cantilever portion of the structure is to be divided into two parts, the east and the west channel crossing, separated by West Brothers Island. In the west channel there are to be three 1,200-ft. main spans and two 500-ft approach spans; in the east channel one 1,200-ft. main span with two 500-ft. approach spans. All these spans are to be 135 ft. above water level and will consist of cantilever arms with a central suspended span, much the same design as that used at Carquinez. The design provides for heavy trucks or electric interurban railway but no steam railway.

C. Derleth, Jr., Berkeley, Calif., is consulting engineer for the Richmond San Rafael Bridge, Inc., which was formed to carry out this project.

Lake Michigan Cities Report Sanitation Progress

Progress in cleaning up Lake Michigan by sewage treatment and in safeguarding the health of the cities bordering on the lake by filters were subjects claiming the attention of the fourth convention of the Lake Michigan Sanitation Congress Sept. 30 and Oct. 1 at Waukegan, Ill. The existing officers were re-elected: Major Henry W. Lee, president; C. M. Osborn and P. R. Taylor, vice-presidents; Mrs. E. W. Bemis, secretary and Walter Schrage, treasurer. The proceedings are now issued quarterly.

Recent activity of the cities include employment of consultants for proposed sewage treatment at Michigan City and Muskegon. Milwaukee now treats 83 per cent of its sewage and in three months will handle all of it, Robert Cramer, chief engineer of the Milwaukee Sewerage Commission, reported. Racine has water filters completed and engineers are working on sewage plans. Kenosha has filtered its water for 10 years but will ask bids on additions about Jan. 1, 1928. Sewage plans are being studied, L. R. Howson reported for Racine and Kenosha. Col. Henry A. Allen described the partly completed filters for Waukegan. S. A. Greeley indicated that the North Shore Sanitary District, which includes the cities on the lake in Lake County, was completing its seventh plant (first unit for Waukegan). Langdon Pearse outlined progress of the Sanitary District of Chicago.

Although Hammond, Whiting and East Chicago had a report by the Randolph-Perkins Co. more than a year ago recommending a sanitary district nothing has been done. Lewis S. Finch, state sanitary engineer, Indiana State Board of Health, said those cities would be called to account shortly to show cause as to why they were not taking steps to comply with a mandatory order to cease the discharge of sewage into the lake. The limit of the order, which was passed in 1924, was Jan. 1, 1926.

Bacterial condition of the lake and of the water supplied to 18 cities from Waukegan south to Gary was given in a paper by Dr. F. W. Mohlman and C. C. Ruchhoft, Sanitary District of Chicago. Samples taken daily indicate Chicago gets the best water due to the vigilance of chlorine application. Evanston and Gary come next. The cities in the Calumet region get the worst water.

American Engineers Urged By Baron Shiba to Aid World Congress in Tokyo

American co-operation is essential for the success of the World Engineering Congress to be held in Tokyo in 1929, according to a statement made by Baron Shiba on Oct. 7 at a luncheon given in his honor at the University Club, New York, and attended by more than 60 American engineers—including consulting engineers, industrial and utility executives and officers of national engineering societies. Baron Shiba, as official representative of fourteen Japanese technical societies, reported progress in the preparations for the Congress and received formal assurances of American assistance.

Engineers, said Baron Shiba, can learn a lesson from the scientists in the matter of international co-operation. The former have yet to stage an international meeting comparable with the third Pan Pacific Science Congress held in Japan last year. Mutual understanding is a valuable by-product of such meetings.

Engineering standardization, he pointed out, must be conducted on an international basis to facilitate commerce and promote world industry. Such a movement is already under way, as exemplified by the third International Conference on Standardization which met in New York last year. As another example of progress in world-wide co-operation he cited the International Economic Conference at Geneva last summer, where such matters as engineering organization, the rationalization of industry and industrial agreements were debated. These problems, said Baron Shiba, cannot be solved without the active collaboration of engineers of all countries. He emphasized also the importance of international co-operation in engineering research.

Smith Submits Transit Report

(*Continued from p. 609*)

now need any increase in fares, so long as the people accept the present quality of service and the city makes the taxpayers pay the fixed charges of the city's investment."

Among the recommendations of Mr. Smith's report that may be of material interest outside of, as well inside, New York City, are the following proposals: That the present companies carry on a unified system of operation of all transit facilities and pool the revenues; increase fares as already stated; build up a surplus for the benefit of the city; and raise or lower fares as conditions warrant; divide profits, one-fourth to the companies, one-half to the surplus fund, and one-fourth to the employees, the latter including everybody from president to the humblest person on the payroll; amortization so as to bring all the railway properties into the eventual ownership of the city; arrange to assess any part of the fixed charges against increased property value; fares to be adjusted by a Board of Control including the chairman of the Transit Commission, the city comptroller and one representative of the companies.

The report of Mr. Smith, as unofficially made public, may be found in the *Herald-Tribune* and in the *World*, of New York City, Oct. 6, 1927.

Wisconsin Concrete Paper Mill Building Fails

Failure of one of the Kimberly-Clark Paper Co. buildings at Kimberly, Wis., on Oct. 7, resulted in the death of six men and serious injury to a score of others. The building was 54 x 74 ft. in size, 2-story and basement, of reinforced-concrete and steel construction, with brick walls on a stone foundation. It contained heavy pulp beaters and was also used for pulp storage. Apparently the floors and roof dropped vertically into the basement from a cause not yet determined.

Fuller details will be given in these columns upon the report of the State Industrial Commission now making an investigation.

Unfavorable Report on Piedmont & Northern R.R. Extension

Proposed construction of 128 mi. of new railroad between Spartanburg, S. C., and Gastonia, N. C., by the Piedmont & Northern R.R. was reported upon unfavorably last week by an examiner for the Interstate Commerce Commission. The report recommends refusal of the necessary authority to proceed, as the construction of the new line would result in unwarranted duplication of railroad facilities, impairment of the business of the steam railroads now operating through the territory, and would not render material public service.

Railroads in N. Y. Pledge Grade Crossing Elimination

Executives of 31 railroads operating in New York held a conference at Albany on Oct. 10, upon invitation of Governor Smith, and pledged to undertake a program of grade crossing elimination suggested by the state which is one of the most comprehensive ever attempted. The program contemplates beginning work in 1928 with the elimination of 74 crossings in New York City, at an estimated cost of $116,000,000, and 202 crossings throughout the state at an estimated cost of $33,441,000.

Award Brooklyn Subway Contract

The Board of Transportation of New York City awarded a contract on Oct. 8 for the construction of the Jay St. section of the city's new subway system in Brooklyn to the Carleton Co. at $3,758,992, the lowest of 18 bids. This section is a four-track line, extending on Jay St. from Nassau to Willoughby St.

San Francisco Engineers Club Dedicate New Home at Pine and Sansome Sts.

The goal of many years' endeavor was reached by the Engineers' Club of San Francisco when its new home was dedicated on Sept. 30. This club, which is now fifteen years old, includes in its membership engineers engaged in all branches of the profession, the total membership being about 750. Because San Francisco is far from the headquarters of the national engineering societies the club has made a point of close relationship with these organizations.

The new quarters occupy the two top floors, 14th and 15th, of a new building at Pine and Sansome Sts. The space was arranged in the design of the building expressly to suit the needs of the club and great care was taken in the selection of furnishings and equipment. The completed plant is particularly well adapted to serve as the focal point for engineering society activities in the San Francisco Bay region.

At the dedication ceremonies congratulatory wires were read from Herbert Hoover who is a member of the club, Charles M. Schwab, president, American Society of Mechanical Engineers, H. Foster Bain, secretary, American Institute of Mining & Metallurgical Engineers, W. S. Sproul, president, Southern Pacific R.R., James H. McGraw, president McGraw-Hill Publishing Co., Calvin W. Rice, secretary, American Society of Mechanical Engineers, and others.

The address of dedication, by President N. A. Bowers, western editor, *Engineering News-Record*, stressed particularly the opportunity and the obligation of the club to render service of high order to the engineering profession as a whole.

Other addresses were as follows: "The Engineer from the Viewpoint of Finance," by F. L. Lipman, president, Wells Fargo Bank & Union Trust Co.; "The Engineer's Place in Industry," by Charles W. Merrill, metallurgical engineer; "The Public and the Engineer," by Chester H. Rowell, editor and publisher.

To Ask Thousand Islands' Bridge Charter

Application for a federal charter for the proposed Thousand Islands bridge to cross the St. Lawrence River from Rockport, Ontario, to Collins Landing, N. Y., will be renewed at the next session of the Canadian Parliament by the promotors of the Thousand Islands Bridge Co. Definite information to this effect has just reached Ottawa, from W. Gilbert Freeman, of Glen Falls, the original promoter. The application was turned down by the private bills committee of Parliament last session, pending the decision as to what point on the St. Lawrence will be chosen as the deep water terminal in connection with the Welland canal project.

Word Engineer Eliminated from Non-technical Positions

The word "engineer" has been eliminated from sixteen non-technical positions in the city engineering department by the Los Angeles Civil Service Commission. Elimination of this word and the substitution of "operator" were due to the efforts of R. W. Stewart, a director of the Los Angeles chapter of the American Association of Engineers. The word "engineer" carried the following qualifying titles before the change was made: assistant tug boat, tug boat, assistant steam, plant engineer and repair man, city hall, junior plant, plant, senior plant, stationary steam, gas roller, steam roller, steam shovel, locomotive, Diesel electric pumping plant, hoisting and pile drive. These non-technical positions now carry the titles of assistant tug boat operator, etc.

Aurora, Ill., Votes $1,000,000 for Sewage Disposal

A bond issue carried by a large majority of the voters in the Aurora Sanitary District, at Aurora, Ill., on Sept. 22, provides $1,000,000 towards the cost of a plant to prevent the discharge of sewage into the Fox River. As this is the maximum amount that could be voted under the state's sanitary district law, while the plans for the sewage disposal program involve a total expenditure of $1,160,000, the excess amount will have to be secured from the annual tax levy. This levy was doubled at the same election and now amounts to $120,000. The plans provide for intercepting sewers and sewage treatment, the latter by means of tanks and sprinkling filters at a site about three miles below the city. This is one of the constructive steps towards cleaning up the Fox River. Other cities along that stream already have sewage-works in hand. A part of the drainage area outside of the cities is under the protection of the Fox River Conservancy District, but this organization has taken no action as yet. The engineers for the Aurora works are Alvord, Burdick & Howson.

Western Air Express to Get Aid From Guggenheim Fund

The Western Air Express, which is to establish an airplane route between San Francisco and Los Angeles, has been promised the first equipment loan to be made by the Daniel Guggenheim funds for the promotion of aeronautics.

The quoted comment of Daniel Guggenheim is as follows:

An equipment loan to finance the purchase of three multi-motored modern passenger-carrying airplanes to be operated on a model passenger airway between Los Angeles and San Francisco by the Western Air Express, has been authorized by the trustees of the Daniel Guggenheim Fund for the Promotion of Aeronautics. It is the intention of the Western Air Express to establish regular service on this line early next year on a 3-hr. daylight schedule over a route which, in accordance with the Fund's policy must be approved for passenger transport by the Aeronautics Division of the Department of Commerce.

The passenger service between the two cities named is to provide planes leaving either terminal at 10:30 a.m. daily and arriving at the other terminal at 1:30 p.m. The distance by air line is 365 miles. Planes are to have a cruising speed of about 120 miles per hour and a cargo capacity of about 2 tons.

Random Lines

RAMBLING LINES

By Elldee

Of all the jobs a man must fill
To keep his better half's good will
And furnish breeches for his frame
And draperies for wifie's same,
From rehabilitating hats
To filing saws or skinning cats,
It seems that of the engineer
Brings oftenest a groan or tear.

The nature of this gaffer's job
Calls for a tried and trusty knob,
A patience grim, the heart to work
With no desire to loaf or shirk,
A knack of sticking to the truth—
Tho it may cost an eye or tooth—
A handy mitt for drawing lines
Or checking prints or painting signs.

The engineer must learn to sit
(And this takes lots of sand and grit)
For eight hours at a stretch, or more,
And add up figures by the score
Without conniption fits to spoil
The product of his grinding toil,
Altho his legs be petrified
And crawly feelings shrink his hide.

The pugilist, who makes his tin
By taking punches on the chin
Or wallops on the eye or spleen,
Is not so dingbeswabbled green
As he who builds, or engineers,
The nation's sewers, dams or piers—
For, after all is said and done,
He is the gink who cops the mon!

A college course in cracking chins
And blacking eyes and kicking shins
And strewing ribs about a ring—
At this time seems to be the thing,
If one in this old world would rise
To gladsome rags and custard pies!
For engineering, as a rule,
Will scarcely keep one in white mule.

* * *

Why Worry?

Sir—Did you see in the *Saturday Evening Post* whither we are tending? It's in the August 20 number in an article entitled "A Manual of Education for the Educated" by Corra Harris. Mrs. Harris is concerned at the future cost of education for, she says, it is a "conservative estimate that the population of the country will be doubled thirty-two times within the next hundred years."

A few minutes exercise on the slide rule discloses the fact that if the census figures for 1926 be taken as a base, the population of the United States in 2026, according to this "conservative" estimate, will be 503,100,000,000,000 individuals, which is equivalent to an average density of 33.5 per square inch.

I can certainly see plenty of work ahead for structural engineers.

T.P.Y.

C. E. Fowler To Apply for N. Y. Toll Bridge Franchise

Charles E. Fowler, consulting engineer and president of the Fowler Engineering Corporation, has filed a preliminary application for a franchise to construct a $60,000,000 traffic toll bridge over the Narrows between Brooklyn and Staten Island. In his application for franchise filed in the office of Mayor Walker, he stated that, should his plan be approved in principal, he will make formal application to the proper authority. Preliminary plans indicate a clear span over the Narrows, from near Fort Hamilton in Brooklyn to Staten Island, of not less than 4,200 ft. The bridge would be of the suspension type, the towers being some 765 ft. high, allowing a vertical clearance of 215 ft. at the towers and 235 ft. in the channel. The floor would be 200 ft. wide with a roadbed for twelve traffic lanes.

The Week's Bridge Applications Made to Secretary of War

Applications Approved: The Assistant Secretary of War, Colonel Hanford MacNider, has approved the following:

1. Application made by the Ocean City-Longport Automobile Bridge Co. for approval of plans of a bridge to be constructed over Great Egg Inlet, from Ocean City to Fish Factory Island, New Jersey, under authority of state law.

2. Application made by the Board of County Commissioners, St. Johns County, Florida, for approval of plans of a bridge to be constructed over the Matanzas River, 8 miles south of St. Augustine, Florida, under authority of state law.

3. Application made by State Road Department of Florida for approval of revised plans for a bridge authorized by an instrument signed by the Assistant Secretary of War, Oct. 16, 1926, to be constructed over the Alafia River near Riverview, Florida, under authority of state law. The revised plans provide for ten 30-ft. reinforced-concrete girder spans, resting on concrete pile bents and one double-leaf bascule draw span instead of two steel truss spans, 120 ft. in length and a swing draw span 150 ft. in length, as specified in original application.

4. Application made by the Pomeroy-Mason Bridge Co. of Charleston, West Virginia, for approval of plans of a bridge to be constructed over the Ohio River at Pomeroy, Ohio, under authority of an Act of Congress approved Feb. 25, 1927.

5. Application made by the Pond River Bridge Co., Wilmington, Delaware, for approval of plans of a bridge to be constructed over Pond River near Ashbyburg, Kentucky, under authority of state law.

Ohio River Bridge Approved: The War Department has approved the plans of a bridge to be constructed over the Ohio River at St. Mary's, West Virginia, under authority of an Act of Congress approved March 2, 1927.

Three Bridge Contracts in Virginia Awarded Turner

The James River Bridge Corporation has let to the Turner Construction Co. of New York City the contract for the construction of bridges across the James and Nansemond rivers and Chuckatuck Creek, between Newport News, Va., and Norfolk, Va., at a cost of approximately $5,000,000. The three bridges have a total length of 30,675 ft., while the connecting roads are of a total length of about 5 miles.

On the section over the James River, which is the principal waterway crossed by this series of bridges there will be a 300-ft. lift span having a maximum clearance of 145 ft. above mean high water. On each side of this lift span there will be four 210-ft. through trusses with a clearance of about 50 ft. above mean high water. For the other two rivers there will be 90-ft. bascule lift spans. The rest of the bridge work is a combination structural steel and concrete trestle work consisting of 40-ft. spans. The roadway will have a width of 25 ft.

J. E. Greiner Co., of Baltimore, are the engineers.

St. John Plans Harbor Work

The Board of Harbor Commissioners of Saint John, New Brunswick, has authorized its chief engineer to prepare plans for additional port equipment, wharves, elevators and up-to-date appliances, including also plans for a harbor bridge to replace the present ferry and to give the Canadian National Rys. access to the western side of the harbor. This marks the first definite step in port improvement since the harbor was placed under a commission through federal government legislation a few months ago.

Business Notes

JAMES C. ADAMS, assistant city engineer of Binghamton, N. Y., has been appointed village engineer of Johnson City, N. Y., by the Board of Trustees. Mr. Adams succeeds the late Frank A. Tillman. His selection was made from a list of five applicants.

E. W. MCCULLOUGH, consulting engineer to the Indianapolis Sanitary Commission in charge of design, construction and latterly of operation of the garbage reduction plant, has been appointed general manager of both the garbage and sewage-works under a three-year contract, dated back to June 16.

F. H. CLARK, consulting engineer, announces the opening of an office at 949 Broadway, New York, where he is prepared to make examinations and reports on railway and allied industrial problems and undertakings. Mr. Clark's earlier experience included sixteen years service in the motive power department of the Chicago, Burlington & Quincy R.R., six of which were in the position of general superintendent of motive power. This was followed by eight years service on the Baltimore & Ohio R.R. Seven years have since been spent as technical adviser to the Ministry of Communication of the Republic of China, on standardization of equipment and on various questions of railway engineering and operation.

THOS. J. LOUGH, district materials engineer of the U. S. Bureau of Public Roads, with headquarters at Omaha, Neb., has resigned to enter business in Detroit, Mich. Mr. Lough has been actively engaged in engineering work, principally in the highway field, since his graduation from the Massachusetts Institute of Technology in 1913. For the past six years he has been in the employ of the U. S. Bureau of Public Roads.

THOMAS HENRY HOGG, hydraulic engineer of the Ontario Hydro Electric Power Commission; James Lewis Morris C.E.; and David Law Hodges Forbes, M.E., general manager of the Teck Hughes Mining Co. of Kirkland Lake, Ont., have been awarded the degree of doctor of engineering by the University of Toronto.

Engineering Societies

Calendar

Annual Meetings

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Meeting with American Public Health Association, Cincinnati, Ohio, Oct. 17, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Fall meeting, Birmingham, Ala., Oct. 17-19, 1927.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago, Ill.; Annual Meeting, Minneapolis, Minn., Oct. 18-20, 1927.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Dallas, Texas, Nov. 14-18, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual meeting, Washington, D. C., Dec. 1 and 2, 1927.

THE IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION, at its annual meeting at Council Bluffs, Sept. 28 to 30, decided to take a letter ballot on changing its name to correspond with the territory represented. Besides Iowa this section already includes Missouri, Nebraska and South Dakota, and will also include Kansas if a pending petition to that end is approved by the executive committee of the association. Thomas J. Skinner, of the St. Louis Water Department, was elected as chairman of the section; other officers will be appointed later. The secretary is Jack J. Hinman, Jr., Iowa City, Iowa. Papers read included the following: "Filter Plant Operation at Variable Rates," Harry N. Jenks; "Water-Works of Marshalltown, Iowa," Hans V. Pedersen; "Turbidity and Coagulant Dosage," K. C. Armstrong; "Construction Work of the Omaha Metropolitan Utilities District," H. V. Knouse; "Accounting and Financing," Joseph Hail; "Runoff from Small Catchment Areas," Floyd A. Nagler; "Electrolytic Cells for Destruction of Algae," J. B. Thornell; "The New Pumping Station at Council Bluffs," Arthur L. Mullergren; "Green Bile as Used at the Omaha Filter Plant," K. C. Armstrong. It was recommended that the 1928 meeting be held at Kansas City, Mo.

THE TECHNOLOGY CLUB OF SYRACUSE, INC., AND AFFILIATED SOCIETIES will be shown motion pictures of the most interesting features in the construction of the Conowingo hydro-electric development from the start of the work until the present, at its regular meeting on Oct. 17. At the same time the generation of electricity from coal will be shown in the film "From Coal to Electricity." Both films will be presented by A. A. Northrop of Stone & Webster, Inc., Boston, from whom they may be obtained for meetings either of engineering societies or by professors at engineering schools for the benefit of their classes.

Obituary

FREDERICK R. LASSOIE, Seattle, Wash., chief field engineer of King County, died recently in Seattle, at the age of 41 years. He had been in the employ of King County for twenty years.

ADAM M. FAHRINGER, aged 89, and one of the oldest civil engineers in Denver, died Oct. 2. He started his engineering work in Colorado in 1858 and was active therein until a few years ago, when he retired.

RICHARD B. ROGERS, designer and constructor of the lift locks at Peterboro, Ont., died in Peterboro Oct. 2, aged 71 years. It was while he was superintending engineer of the Trent canal system that Mr. Rogers carried through the work which made him well-known in the engineering profession. He was a graduate of McGill University and a charter member of the Engineering Institute of Canada.

BRIG.-GEN. HENRY L. ABBOT, retired, the oldest living graduate of West Point, died in Boston Oct. 4, aged 96. Beside an eventful military career, General Abbot was well known as an engineer and from 1905 to 1910 was professor of hydraulic engineering at George Washington University.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Exhibit of Safety Appliances

An extensive exhibit at the National Safety Congress, held in Chicago, included a variety of appliances, protective clothing, machine guards, first-aid equipment and educational methods. Among them may be listed the following:

Rope and Safety Slings — American Cable Co., New York, N. Y.; Murray Safety Sling Co., Pittsburgh, Pa.; John A. Roebling's Sons Co., Trenton, N. J.; Williamsport Wire Rope Co., Williamsport, Pa.

Floors and Safety Treads — Acme Steel Co., Chicago; American Abrasive Metals Co., New York, N. Y.; Central Iron & Steel Co., Harrisburg, Pa.; Joseph T. Ryerson & Son, Inc., Chicago; Safety Stair Tread Co., Wooster, Ohio.

Scaffolds and Ladders—Dayton Safety Ladder Co., Cincinnati, Ohio; Patent Scaffolding Co., Chicago.

Hand Trucks and Elevating Trucks—Barrett-Cravens Co., Chicago; Fisher Equipment Co., Chicago; Miller Hand-Truck Brake Co., Chicago; Nutting Truck Co., Faribault, Minn.; Steubing Truck Co., Cincinnati, Ohio.

Unbreakable Glass — Triplex Safety Glass Co., Chicago; Safety Corp., Adena, Ohio.

Fire Extinguishers—American Fomon Co., Philadelphia, Pa.; Fyre-Freez Corp., New York, N. Y.; Fyr Fyter Co., Dayton, Ohio.

Traffic and Crossing Signals—Burress Grade Crossing Protection Co., Fort Worth, Tex. (Gates); Essco Mfg. Co., Peoria, Ill.; General Traffic Light Co., Buffalo, N. Y.; Griswold Safety Signal Co., Minneapolis, Minn.

Railway Switch Lock — Elliott Frog & Switch Co., East St. Louis, Ill.

Business Notes

KENNEDY VALVE MFG. CO., Elmira, N. Y., announces the appointment of R. J. Flanagan as manager of its Chicago sales office and warehouse. His previous position as Elmira district representative is being taken by J. T. Connelly, who has been transferred from the Cleveland sales office. W. E. Blake is to replace Mr. Connelly in Cleveland.

C. G. MCDONOUGH has recently been appointed director of sales of the Selden Truck Corp., Rochester, N. Y. He goes to his new work from the Kelly Springfield Truck & Bus Corp., Springfield, Ohio, of which he was sales manager. Previous to this, he was sales manager of the commercial car department of the Willys-Overland Co., Toledo, Ohio.

CHICAGO PNEUMATIC TOOL CO., New York City, announces the appointment of J. C. Fitzpatrick as district manager of sales, Cleveland, succeeding J. L. Westenhaver, who has resigned to enter business for himself.

NEW YORK BLUE PRINT PAPER CO., New York City, announces that, effective immediately, it has changed its name to the Charles Bruning Co., Inc. Its Boston branch, known as the Blue Print Co., its Newark branch, known as the Architects & Engineers Supply Co., and its Chicago branch, known as the American Blue Print Paper Co., all will assume the new name. The Rapid Blue Print Co., Los Angeles, has recently been acquired, and will also be known under the new name. The change in name has been dictated by the expanding business of the company since it was founded about thirty years ago as a commercial blue-printing establishment. In addition to this original phase of the work, the company now has a capacity for coating more than 50,000 yd. of blueprint paper a day, manufactures drafting-room furniture and supplies, and imports and jobs a complete line of drawing and tracing papers, as well as miscellaneous supplies such as drawing and engineering instruments.

SPEEDER MACHINERY CORP., Cedar Rapids, Iowa, announces that Glen D. Cooper has been appointed assistant sales manager.

ALEXANDER MILBURN CO., Baltimore, has opened a new office in Boston, in the Wiggin Terminals Building, under the supervision of M. B. Crouse and G. B. Malone. This office will handle the sale and distribution of Milburn welding and cutting apparatus and other equipment throughout the New England states.

WHITE CO., Cleveland, has just opened a new branch sales and service building for its motor trucks in Los Angeles. The building which cost $500,000 has one story and basement, covering 132,000 sq.ft. of floor space. Four other new buildings for company branches are now under construction.

The Bronx branch which will serve part of the territory now handled from the New York City branch in Long Island City, will be completed about the middle of October. The other new buildings are in Providence, R. I., Hartford, Conn. and Syracuse, N. Y., and will be completed during November and December.

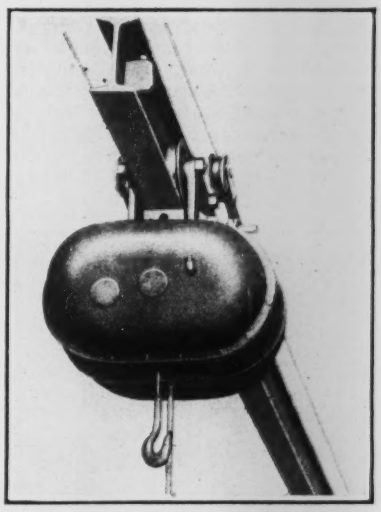
AMERICAN ENGINEERING CO., Philadelphia, announces the following appointments in Pittsburgh and Cleveland as direct factory representatives for its Lo-Hed hoists: D. A. Polhemus with John Kaiser, assistant, Oliver Building, Pittsburgh; W. C. Minier, 2195 Bellfield Ave., Cleveland.

CLIMAX ENGINEERING CO., Clinton, Iowa, announces the appointment of John Reiner & Co., Inc., 309 Church St., New York City, as its service representative for the states of Connecticut, New York and New Jersey.

New Developments

Electric Hoists Built in ¼-Ton Capacity

An all-steel ¼ ton electric hoist is a recent product of the American Engineering Co., Philadelphia. It is a high speed model with pressed steel frame,



chrome-manganese steel in the gears and shafts, ball bearings, a non-spinning hoisting rope, oil bath lubrication, push button control and upper and lower limit switches. All working parts are fully enclosed. The hoist weighs 200 lb. and is made in two types, plain trolley and hook suspension. The plain trolley type requires 16-in. headroom and the hook suspension type 18-in.

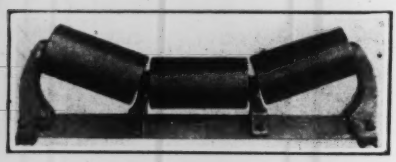
Crane Unit Developed for Tractor Mounting

A crane unit known as the "Tractocrane" has been developed by the Vergan Schmidt Co., Champaign, Ill., built with either a Fordson or McCormick-Deering tractor for power unit. The equipment is available on rubber tired wheels semi-crawler or full crawler traction, with a 20 or 25-ft. boom, ⅜ or ½-yd. clamshell bucket, ⅜-yd. shovel boom, ⅜-yd. trench hoe, or a fall block. All attachments are interchangeable. Among the machine's special features are a self-contained generator and magnet for handling pipe, etc. The Tractocrane weighs from 16,000 to 20,000 lb., has a wheel base of 137 in. and a width of 8½ ft. Power trans-

mission is by worm gears controlled by friction clutches both on the boom hoist and the swinging mechanism. A ratchet friction drum is used for the opening and closing line and an automatic drum is provided for the bucket hold-line.

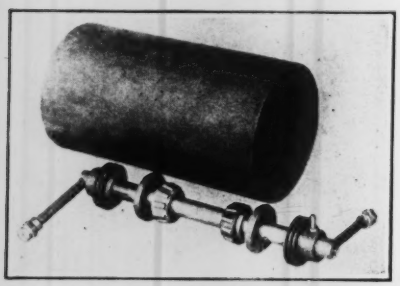
New Line of Conveyor Carriers for Belts Up to 60 in. Wide

A belt conveyor carrier, consisting of three rollers in line, the troughing rollers being mounted at a 20-deg. angle, represents a new design recently de-



veloped by Stephens-Adamson Mfg. Co., Aurora, Ill. The complete line includes carriers for belts ranging in width from 12 to 60 in. The carriers are mounted on heavy steel angle section base, and the whole assembly tilted slightly in the direction of belt travel in order to facilitate the proper training of the belt.

The rollers are made of steel tubing



with drawn steel end plates. Each roller is equipped with two Timken bearings. The permanent adjustment of the bearings is provided for by lock screws. Lubrication of the rollers is of high pressure grease type, each shaft being equipped with two pressure fittings.

Direct-Acting Venturi Controller for Filter Plants

For automatic rate control of the filter effluent from small and medium sized filter plants, the Builders Iron Foundry, Province, R. I., has recently developed a new direct-acting controller. The three important elements of the new controller are the Venturi tube, the diaphragm (in the flat disk casting in the

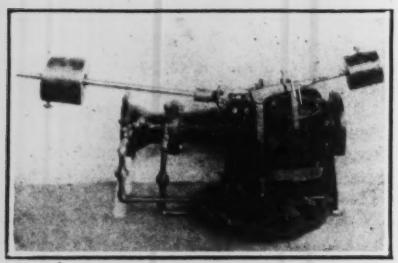


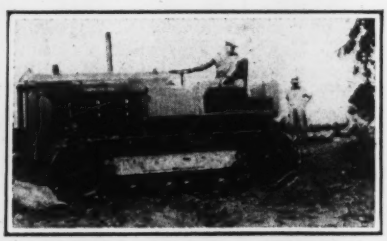
illustration), and a balanced rotary valve. The water pressures at the inlet and throat of the Venturi tube are carried to the upper and lower surfaces of the diaphragm by the two small pipes shown in the accompanying illustration. The pressure differential thus set up acts upon the diaphragm and upon levers to operate the rotary valve controlling the rate of effluent. This differential pressure is balanced by the counterweight, which can be set for any rate of flow desired. The scale beam is graduated in gallons per day.

The diaphragms are made of especially strong canvas fabric impregnated with rubber, and can be replaced without interrupting the flow. The whole equipment is of rugged design throughout. Knife-edge frictionless bearings are used and all parts coming in contact with water are made of a corrosion-resisting metal. The inlet vent holes are bronze-bushed, while the throat is bronze-lined and machine-finished. The controller is claimed to be so simple in construction that its operation and care does not require skilled attention.

New Tractor Features Large Draw-Bar Pull and High Speed

The new Cletrac "100," just introduced by the Cleveland Tractor Co., Cleveland, Ohio, has been designed to develop unusual draw-bar horsepower and draw-bar pounds pull along with high speed on the crawlers. These speeds vary from 1¾ m.p.h. in low to 4.6 m.p.h. in high. The tractor has a rating at the drawbar of 100 hp. and at the power pulley of 120 hp. The maximum draw-bar pull at 1¾ m.p.h. is 21,000 lb.

The power unit is a six-cylinder, four-cycle, water-cooled, valve in head engine, with force feed lubrication to the crankshaft, camshaft, connecting rods and wrist pins, and splash lubrication



to the cylinder walls. All shafts and gears of the transmission are made of alloy steel and heat treated, and all gears run in a bath of oil supplied by a gear-driven oil pump.

Steering is accomplished by the motor through planetary compensating gears. As pressure is applied to either side of the brake drums by the steering gear, the track on the drum to which the pressure is applied slows down, causing the opposite track to speed up. The drive sprocket wheels are supported in extra large shafts mounted on heavy duty ball bearings. On the lower track, wheel assemblies are of plain bearing design, lubricated by the use of two one-shot force-feed oil systems. The tracks are 19 in. wide with grousers 2(in. wide. The tractor is 7 ft. 2 in. high, 8 ft. wide with grousers, and 14 ft. 10 in. long over all.

Manufacturers and Trade Associations

Calendar

Annual Meetings

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; Annual convention, Pinehurst, N. C., Oct. 25-29.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. Sixth Annual Show. New York City, Dec. 5-10.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; Annual Convention, Detroit, Jan. 4-6, 1928.

ASSOCIATED EQUIPMENT DISTRIBUTORS, Milwaukee; Annual meeting, Cleveland, Jan. 6-7, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 16-19, 1928.

New Publications

Rapid Hardening Portland Cement—CEMENT MARKETING CO., LTD., Portland House, Tothill St., Westminster, S.W.1, England, has issued a 60-page catalog describing "Ferrocrete" which is a rapid hardening Portland cement. Graphs and tables are given of tests on the cement and many illustrations of paving works in England using this cement are shown. Other illustrations show pre-cast slabs, pipe lines, buildings, piles, etc., in which "Ferrocrete" has been used.

Weighing Hoppers—BUTLER BIN CO., Waukesha, Wis., has just issued Bulletin No. 150, in which it devotes 12 pages to illustrating and describing the application of its weighing hoppers to the proportioning of concrete aggregates. Besides the illustrations a number of line drawings are given showing the hoppers in detail. Information is also given on the manner of installing the hoppers and on the operation of the dial scale and beam scale types.

Hoists—NATIONAL HOISTING ENGINE CO., Harrison, N. J., has issued a folder containing three bulletins, S, E, and G, respectively illustrating and describing the company's many types of steam, electric and gasoline hoists. Each page is devoted to a separate hoist, descriptive matter being arranged in tabular form. The three bulletins total 40 pages.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Costs Culled From Construction News

100,000 gal. tank on 75 ft. tower for Oxford, Md., $6,310.

66-in. brick sewer, double ring, 1,035 ft., for Boston, Mass., $44.23 per lin. ft.

Retaining walls at Cleveland, O., 1,700 ft., 1,100 ft., and 300 ft., each 40 ft. high and 2 to 10 ft. thick, estimated $129 per lin.ft.

Concrete paving at Pontiac, Mich., 93,900 sq.yd., 20 ft. x 9 in. at $3.46 per sq.yd.

Gravel in Iowa, Howard County, 12,227 cu.yd., one mile haul, 48c. per cu.yd.; for Palo Alto County, 7,000 cu.yd., one mile haul, 39c.; for Sioux County, 7,700 cu.yd., one mile haul, 30c.

4,000 bbl. cement, bought by Banta Irrigation Dist., Tracy, Calif., from six companies, for $2.41 per bbl. net.

Road materials for Brooklyn, N. Y., bought at following prices:

400,000 gal. asphaltic cement	$0.0634
4,800 cu.yd. binder stone	1.94
2,500 tons powdered limestone	4.87
4,000 cu.yd. asphalt sand	.97

8- and 10-in. pipe line for natural gas in Texas, 118 miles, at $5,500 per mile.

Florida Had Heaviest Construction Year In 1926

MORE money was invested in heavy engineering construction in the state of Florida last year, than in any year since 1917, according to *E. N.-R.* statistics. The total for 1927 will probably run somewhere between the 1925 and the 1926 figures. Contracts included in the accompanying table, were taken at the minimum for each class, mentioned at the top of p. 616. It will be noted that 1920, the year of nation-wide inflation, shows the lowest total for heavy construction in Florida, of any year in the 1917-26 period. Repetitions of the exceptionally heavy expenditures for excavation projects in 1917 and 1925, commercial buildings in 1925 and 1926, and water-works in 1924, will not appear in this year's figures or even those of 1928, according to present trend in proposed work. Totals by years and classes follow:

Bureau of Labor Statistics Changes Index Base from 1913 to 1926

ANNOUNCEMENT is made that the Bureau of Labor Statistics of the Department of Labor has completed the revision of its index numbers of wholesale prices and the results are now ready for distribution as Bulletin No. 453.

At last 1913 no longer equals 100 in the bureau's calculations, as the price base has been changed from the average of the year 1913 to the average of the year 1926. Also, the weighting employed is no longer the quantity entering into the market in 1919, but an average for the years 1923 to 1925.

The number of articles included has been increased from 404 to 550, some of these being composites made by averaging the prices of several kinds of an article. This constitutes the broadest range of commodities entering into any price index now being published. A slight rearrangement of commodities has been made in several of the groups, while the former group of "clothing materials" has been superseded by the two groups—"textile products" and "hides and leather products."

A complete list of the commodities in the new index, together with the 1926 base prices and the quantities used as weights, is given in the bulletin. Additions to the list formerly used include, among others, such important articles as agricultural machinery, automobiles and tires, prepared fertilizers, byproduct coke, manufactured gas, gloves, traveling bags and suit cases, rayon, sewing machines, stoves, box board, and mechanical wood pulp. Several articles no longer important, as clay worsted suiting, New York State hops, and Bessemer steel billets and rails, have been dropped.

The shift in the price base from 1913 to 1926 was made in order that the latest and most reliable information might be utilized as the standard for measuring price changes. Also, it has become increasingly more apparent that the year 1913 is now too remote to furnish a satisfactory base for comparing price levels in recent years.

For much the same reasons data for the years 1923 to 1925 have been substituted for the 1919 figures used in weighting the prices. Where trustworthy information for the three years 1923, 1924, and 1925 could be procured, as in the case of agricultural products, the average for these years was used as the weight. For manufactured products the biennial Census reports of 1923 and 1925 were used. In all cases the most recent and dependable information obtainable has been employed in constructing the weighted index numbers for the various groups of commodities. It is the purpose of the bureau to extend the revision of its index numbers further into past years as the exigencies of the work will permit, and additional results will be announced as fast as the computations are completed.

The new index numbers differ somewhat from the old, as is to be expected from the change in articles and the change in weights. Converting the old general index to the same base period as the new (1926 = 100.0) the following differences are noted: The old series for the year 1923 is 101.8 and the new is 100.6. For 1924 the figures are: Old series, 99.1 and new series, 98.1. For 1925 the old series is 105.1 and the new series is 103.5.

New York City Rents Up 100 Per Cent Since 1913

Apartment space that rented for $250 to $275 per room in 1913 now brings $500 to $525 for the same style, according to an investigation made by *Engineering News-Record*, covering apartments, offices and lofts. Cost to build has risen from 30@40c. per cu.ft. to 65@80c. per cu.ft. in the same period.

High-class office space is $4@$5 per sq.ft., compared with $2.25 in 1913. Loft space is $2@$2.50 per sq.ft., compared with $1@$1.25 in 1913. *Engineering News-Record* would be glad to hear from its readers regarding the rise of rents in other cities.

VALUE OF CONSTRUCTION CONTRACTS LET IN FLORIDA IN LAST TEN YEARS AS REPORTED BY ENGINEERING NEWS-RECORD

Thousands of Dollars (-000 omitted)

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Water-works	.....	$20	.....	.....	$20	$406	$54	$1,833	$35	$195
Sewers	$149	40	$162	$30	161	881	1,251	637	1,153	3,115
Bridges	1,497	215	912	1,229	1,471	2,970	2,527	175	1,863	2,019
Excavation, drainage, etc.	26,691	958	27	110	455	1,476	730	3,241	16,344	2,075
Streets and roads	13,453	2,729	3,208	4,706	3,055	17,373	16,220	12,261	10,425	49,103
Industrial buildings	52	1,742	290	150	880	70	330	3,210	4,015	4,110
Commercial buildings	230	1,202	1,007	2,330	3,498	5,993	9,938	7,633	23,836	26,227
Federal Government	3,073	3,284	3,172	314	91	498	92	242	802	2,490
Unclassified	1,974	286	257	.....	284	587	1,240	1,385	1,269	12,568
Totals	$47,219	$10,476	$9,035	$8,869	$9,915	$30,354	$32,382	$30,617	$59,742	$71,902

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total U. S.
October 13, 1927	$29,761,000	$19,404,000	$49,165,000
October 6, 1927	23,067,000	42,811,000	65,878,000
October 14, 1926	13,598,000	19,985,000	33,583,000
Jan. 1 to date			
1927	1,019,512,000	1,464,491,000	2,484,003,000
1926	888,961,000	1,397,876,000	2,286,837,000

E.N.-R. Index Numbers

On October 1, 1927

COST	VOLUME
204.40	273
Last Year 209.80	Last Year 227

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, per 100 lb.	$3.34	$3.75	$4.00	$3.10	$3.35	$3.87½	—$3.00	$3.00	$4.00
Structural rivets, per 100 lb.	5.00	4.00	4.75	3.60	3.85	4.64	5.50	5.25	5.50
Reinforcing bars, per 100 lb.	3.24	2.99	2.75	2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in., lap weld, discount from list	48%	40%	54%	51%	48%	41%	42@53.8%	48%	.....
Cast-iron pipe, 6 in. and over, per net ton	42.60	36.50	54.00	—38.20	42.50	56.50	41.00	55.00	41.00
Concreting Material									
Cement, without bags, per bbl.	2.35†	2.40	2.05	2.05	2.22	2.85	2.51	2.65	1.41
Gravel, ¾ in., per cu.yd.	1.75	2.20*	2.38	2.00	1.25*	1.90	1.80	1.25	1.90*
Sand, per cu.yd.	1.00	1.75	2.00	2.00	1.25†	1.00	1.40	1.25	1.35*
Crushed stone, ¾ in., per cu.yd.	1.85	2.50*	2.83	2.00	1.25*	2.50	1.70	3.00	2.00*†
Miscellaneous									
Fir, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	.....	.....	.....	+39.50(S4S)	36.75@38.75	34.25	27.00	—24.00	55.00†
Pine, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	65.00@62.00†	34.00	56.00†	.....	.....	.....	.....	.....	.....
Lime, finishing, hydrated, ton	+19.45	24.50	19.00	20.00†	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl.	+2.35@2.50‡	1.35	1.82	1.50†	1.70	2.70‡	1.70	2.80‡	10.00*
Common brick, per M	16.00@18.00†	12.50	13.60	12.00†	13.75†	8@12	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0724†	.103	.....	.072	.085	..	.10	.10
Hollow partition tile, 4x12x12, per block	.1027	.0724†	.103	.076†	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	.86¼	— 87	.85	—.75	— 88½	—.99	.92	.98	1.03
Common Labor									
Common labor, union, per hour	.90⅝	.30	.....	.90	.....	.....	.62½	.70	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.60	.31¼@.50	....	.62½	.30@.35

*Ton. †Delivered to job. ‡280-lb. net. +Advance. —Decline.

A SLIGHT degree of firmness appears in the market for Douglas fir timbers, compared with prices as of the last week in September. The Chicago price on 3 x 12, 20-ft. material is up $1 per M ft.

Lumber stocks in Minneapolis yards, wholesale and retail, are reported below normal for this season. There has been light demand with little replenishment of reserves. Heavy fall buying is evidently not anticipated in the Twin City district.

Lime prices reflect increasing firmness in the New York market. Southern and Western lime quotations remain unchanged.

Linseed oil is down 3c. per 7½-lb. gal. at Chicago, compared with a week ago. A decline of 2¼c. per 7½-lb. gal. occurred in the Minneapolis market

The passage of a new steel ordinance at Seattle, last month, may prove to be a barrier to foreign steel at this particular point of entry. Under the terms of the measure, stresses may be lightened; it is also required that all steel be marked as to test and melt numbers.

THIS limited price list is published weekly except in the first issue of each month and gives current prices on the principal construction materials in the chief cities. Valuable suggestions on costs of work can be had by noting actual biddings as reported in the Construction News and Unit Prices sections following.

The first issue of each month carries complete quotations for all of the basic materials and for the rest of the important cities, also wage rates for the principal building trades and common labor. The last complete list will be found in the issue of Oct. 6, the next on Nov. 3. Explanation of prices contained in the table will appear from time to time in this section; last shown Aug. 11, 1927, p. 247.

The recent weakness in steel prices has finally extended to dealers' warehouse quotations on the Pacific coast. Structurals are down 10c. per 100 lb. at San Francisco, compared with quotations as of September 30.

Accelerated demand, some of it seasonal, is noted this week in steel rails, plates, railroad spikes, splice bars, bridge and building structurals, and iron castings. Steel wire products are slow. Depression is also evident in pig-iron and steel scrap buying. Unfilled orders on books of the U. S. Steel Corporation were: 3,148,113 tons, Sept. 30, 1927; 3,196,037, Aug. 31; and 3,593,502, Sept. 30, 1926.

Where production has been tempered to demand, prices are slightly higher than September levels, as in: asphalt, brick, and manila rope in Western cities; sewer pipe in the South.

The present trend of the building materials market in general is downward, particularly in the following: iron and steel scrap; re-rolled rails; boiler rivets; fish plates; ship and railroad spikes, at mills; clay products, in the Northeastern states; crushed stone, in the West.